THE CANADIAN GEOGRAPHER LE GÉOGRAPHE CANADIEN

No. 4 1954

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Published by

THE CANADIAN ASSOCIATION OF GEOGRAPHERS

Publié par

L' ASSOCIATION CANADIENNE DES GEOGRAPHES

Price $1.00

APR 28 80

HT Ref

THE CANADIAN GEOGRAPHER LE GÉOGRAPHE CANADIEN

No. 4 1954

GEOGRAPHIC CARTOGRAPHY[1]

J. Ross Mackay, B.A., M.A., Ph.D.

President of the Association, 1953-54

Cartography is intimately interwoven into the whole fabric of geographic thought and research. Indeed, it would be difficult to engage in geographic study without using some aspect of cartography. Maps and geography are so closely associated in the public mind that people naturally expect geographers to be professionally concerned with maps. One distinguished geographer has gone so far as to suggest that if a problem cannot be studied fundamentally by maps then it is questionable whether or not it is within the field of geography.[2] In speaking on Geographic-Cartography, it is my purpose to discuss cartographic research from the geographic viewpoint; to emphasize the need for greater precision in geographic studies; and to examine the position of cartography in the geography curriculum. Geographic-Cartography may be defined briefly as the analysis for mapping purposes and the mapping of economic, social, and physical phenomena with emphasis on spatial distributions.[3]

The emergence of cartography as a distinct and widely recognized academic study for geographers is hardly two decades old, at least in North America. For example, there are about one hundred colleges in the United States and Canada that now offer one or more courses in cartography. Possibly only twenty-five of them gave cartography courses 20 years ago, and only four universities listed cartography as an independent course 50 years ago.[4] Some of the increase in cartography courses is certainly attributable to the phenomenal growth of geography departments in the past few years, for many new ones have been established and old ones enlarged. The growth of departments has made it possible for staff members to offer a greater variety of specialist courses, cartography being one of them. In Canada, there has been a rapid expansion in geography at the college level, especially since 1944.[5] The publication in 1938 of Erwin Raisz's General Cartography[6] was another important factor in stimulating interest in cartography, because it was the first such textbook adapted to geography courses in the United States and Canada. In the academic world, the number of textbooks on any given subject is a pretty sure indicator of student enrolments. Therefore, the lack of a

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[1] Presidential address delivered to a joint meeting of the Canadian Association of Geographers and the Manitoba Geographical Society, Winnipeg, Manitoba, 1954.

[2] Hartshore, Richard: "The Nature of Geography", Ann. Assoc. Am. Geog. 29, 1939, p. 249.

[3] It need hardly be emphasized that many cartographers are not geographers. For a comprehensive definition of cartography, see Modern Cartography, United Nations, Department of Social Affairs, New York, 1949, p. 7. A perusal through World Cartography, United Nations, Department of Social Affairs, New York, 1951, will illustrate the diversity of cartography. See also Wooldridge, S.W. and W.G. East: The Spirit and Purpose of Geography, Hutchinson's University Library, London, 1951, p. 140.

[4] Raisz, Erwin: "Report of the Committee on Cartography", The Professional Geographer, 6, 1954, p. 32.

[5] Robinson, J. Lewis: "The Development and Status of Geography in Universities and Government in Canada", Yearbook of the Association of Pacific Coast Geographers, 13, 1951, pp. 3-13. Stamp, L. Dudley: Geography in Canadian Universities, 1951; Canadian Social Science Research Council, Ottawa, 1951, 75 pp.

[6] Raisz, Erwin: General Cartography; McGraw-Hill, New York, 1938, 354 pp.

cartography book prior to 1938 serves to underline the limited demand then existing for such a book. There were, at that time, a few American books that dealt largely with the drafting of maps and the theory of map projections but these were unsuited to the needs of a geography course in cartography. The literature of Great Britain and of some European countries, particularly Germany, was more abundant, but the books were littled used on this continent. As everyone knows, a textbook is not a necessity in a course, but it is highly desirable for an introductory cartography course, because the material is widely scattered in books and periodicals appearing in English, French, German, Russian, Japanese, and other languages. Consequently, the publication of Raisz' s book was a significant advance for cartography. Not until 1953 was a second textbook, Arthur H. Robinson' s Elements of Cartography, [1] published. It is very fortunate that these two initial attempts at geographic-cartography should have turned out so successfully. Meanwhile, our colleagues in Great Britain have also written several good books in the cartographic field, such as Maps and Diagrams by Monkhouse and Wilkinson, [2] as well as many excellent books on map interpretation. The need for maps in World War II and post-war years has also focused interest in cartography as a career, particularly in the United States where the Army Map Service and other Government agencies employ many cartographers. A parallel situation has not developed in Canada.

GEOGRAPHIC RESEARCH

At the risk of considerable over-simplification, geographic research can be divided into three main types based upon the principal means of conducting research. They are: (1) field research -- the method of employing direct observation; (2) library research -- the study of documents of all types; and (3) cartographic research -- the laboratory analysis of field maps, air photographs, statistics, etc. To illustrate, the mapping of land utilization may be dependent upon field research, a study in historical geography upon library research, and the preparation of population distribution maps upon cartographic research.

Geographers who engage in field studies cannot, like geologists, bring back specimens into the laboratory for detailed analysis. At first thought, this may seem to be a handicap and a disadvantage to the geographer. Yet no one sympathizes with the astronomer when he cannot bring part of Halley' s comet, or the planet Jupiter, or the star Polaris into his observatory for examination. In like manner, the geographer cannot physically bring his objects of study into his cartographic laboratory, but he can do so by means such as field sketches, maps, aerial photographs, and statistics. There, by using maps, he can reduce his objects of study, whether county, country, or continent, to manageable proportions, to scales permitting detailed and careful analysis. "The map' s basic contribution is to reduce reality to a scale which can be comprehended". [3]

It seems to me inevitable, and I might add highly desirable, that cartographic research will become each year more empirical, quantitative, and statistical. To me, this augurs well for the future of geographic research, because all phases of geography will benefit from such a direction of progress. I am not stating a new idea, but am re-emphasizing one that others have forcefully expressed before.

C.C. Colby concluded his presidential address to the Association of American Geographers in 1935 by saying: "... the geographic thought in the coming decades, I predict, will call for much greater accuracy and much deeper penetration than has been true in the past. The application of statistical methods, I believe, will introduce new types of measurement. will clarify present methods of analysis, and will give us results which are qualitatively exact as well as qualitatively true". [4] V.C. Finch, in referring to statistical analyses wrote some

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[1] Robinson, Arthur H.: Elements of Cartography, John Wiley, New York, 1953, 254 pp.

[2] Monkhouse, F. J., and H. R. Wilkinson: Maps and Diagrams, Methuen, London, 1952, 330 pp.

[3] Ullman, Edward L.: "Human Geography and Area Research", Ann. Assoc. Am. Geog., 43, 1953, p. 57.

[4] Colby, Charles C.: "Changing Currents of Geographic Thought", Ann. Assoc. Am. Geog., 26, 1936, p. 37.

years ago: "For the coming generation of students this type of training is indispensable".[1] Preston James recently stated: "Geography seeks geometric precision; that is, it is concerned more than bordering fields of study with the exact measurement of areas and patterns, and from these more exact studies of area differences, it brings to light additional understanding of the role of relative location".[2]

Whether we agree or disagree with the thesis that geographic research in general and cartographic research in particular will become more precise, we can at least survey the current trends in those disciplines in which geographers share a great interest. To take an example, let us consider physiography or geomorphology, the study of landforms. For some decades, most North American geographers have been trained according to the William Morris Davis school of physiography, in which the approach to landforms has been primarily explanatory, with little attention paid to the empirical and quantitative elements.[3] The description of the terrain by structure, process, and stage is an illustration of the method. This type of explanatory description of the terrain is admirable for many geographic purposes, but as the years go by it can contribute less and less to geomorphologic research. There has been, therefore, an ever increasing attention given in recent years to empirical, quantitative and statistical studies, as is well illustrated by the recent publications of R, E. Horton,[4] C.C. Bates,[5] and A.N. Strahler.[6]

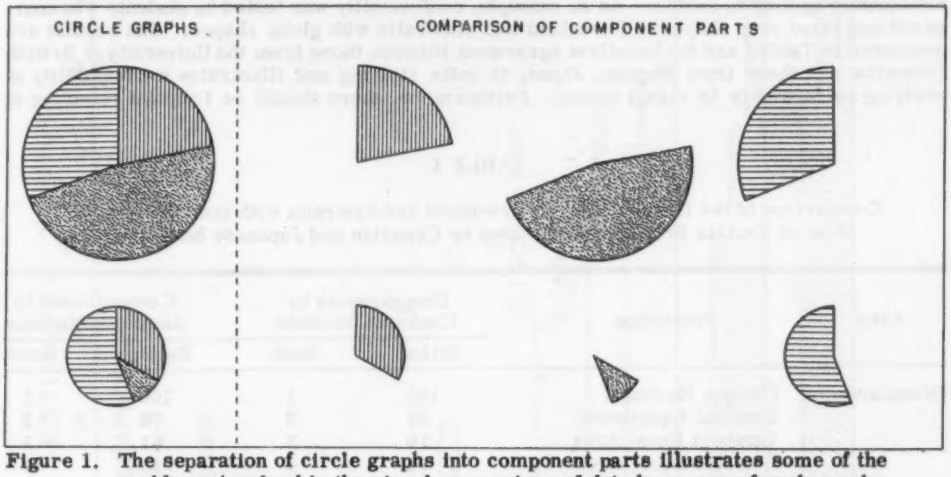

Figure 1. The separation of circle graphs into component parts illustrates some of the problems involved in the visual comparison of data by means of such graphs.

The trend of geomorphologic research is but one illustration of the direction of progress that is so evident in many disciplines, such as climatology in the physical sciences and

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[1] Finch, Vernon C.: "Training for Research in Economic Geography", Ann. Assoc. Am. Geog., 34, 1944, p. 213.

[2] James, Preston E.: "Toward a Further Understanding of the Regional Concept", Ann. Assoc. Am. Geog., 42, 1952, p. 215.

[3] Strahler, Arthur N.: "Empirical and Explanatory Methods in Physical Geography", The Professional Geographer, 6, 1954, pp. 4-8.

[4] Horton, R. E.: "Erosional Development of Streams and Their Drainage Basins; Hydrophysical Approach to Quantitative Morphology", Bull. Geol. Soc. Am., 56, 1945, pp. 275-370.

[5] Bates, Charles C.: "Rational Theory of Delta Formation", Bull. Am. Assoc. Petrol. Geol., 37, 1953, pp. 2119-2162.

[6] Strahler, Arthur N.: "Equilibrium Theory of Erosional Slopes Approached Through Frequency Distribution Analysis", Am. Jour. Sci., 248, 1950, pp. 673-696; 800-814.

economics in the social sciences. In all of them considerable advances are being made by employing, where possible, the tools of the statistician and the experimental method of the chemist. There seems every reason to believe that geographic-cartography will follow the same trend. I feel that a great many of the broad geographic relationships discoverable without the use of such techniques are already known either in whole or in part. We must sharpen our cartographic tools for further geographic research. Towards this end, I would like to suggest three major fields in which cartographic research can play a prominent role.

EXPERIMENTAL CARTOGRAPHY

Little research has been done in experimental cartography and much remains to be accomplished. In the past few years interest in it has grown rapidly.[1] By experimental cartography is meant the objective visual testing on people of cartographic techniques in order to improve those techniques, to discover new ones, and to develop better criteria for selecting the most appropriate mapping method for any specified purpose. The tests should be given to representative groups of potential map users, such as grade school, high school, and college students, because the empirical results obtained from testing one group should not be indiscriminantly applied to another. As an example, conformality was tested by students who compared and rated map shapes of Greenland and Australia with globe shapes. The results are presented in Table I and the excellent agreement between those from the University of British Columbia and those from Nagoya, Japan, is quite striking and illustrates the feasibility of studying conformality by visual means. Furthermore, there should be frequent retesting of

TABLE I

Comparison of the Globe Shapes of Greenland and Australia with their Shapes on Maps of Certain Projections as Rated by Canadian and Japanese Students.

Area	Projection	Comparisons by Canadian Students		Comparisons by Japanese Students	
		Rating	Rank	Rating	Rank
Greenland	Oblique Mercator	100	1	100	1
	Zenithal Equidistant	98	2	76	2
	Lambert Equal Area	70	3	61	3
	Zenithal Equal Area	61	4	55	4
	Mercator	52	5	47	5
	Miller Cylindrical	27	6	24	6
Australia	Miller Cylindrical	100	1	100	1
	Mercator	78	2	84	4
	Homolosine (a)	77	3	74	5
	Modified Gall	73	4	85	3
	Modified Zenithal Equidistant	67	5	89	2
	Oblique Aitoff	33	6	36	7
	Oxford	32	7	40	6
	Homolosine (b)	26	8	29	8

certain mapping techniques, because the results of today may not be applicable tomorrow. There are fashions and styles in cartography just as with clothing and automobiles. Even the north pole has been given the new look in the much publicized polar air age maps that deluge our newspapers, magazines, and books of today, although a little restrospection will remind us that some of the azimuthal projections which are now in vogue were known 2,000 years ago.

[1] The cartography panel at the 1954 meeting of the Association of American Geographers was on "Map Psychology" which is another term for "Experimental Cartography".

Our cartographic tastes also vary with our familiarity or lack of familiarity with cartographic techniques. As an illustration, each year more and more relief maps with the terrain attractively recreated in three dimensions by means of colour shading reach the public by way of magazines, road maps, and so forth. This popularization of a pleasing technique of landscape portrayal will eventually alter the attitude of the public towards other methods of landform representation. The preceding examples show clearly that experimental cartographers will always have a productive field of research, for they deal with the ever-changing attitudes of people.

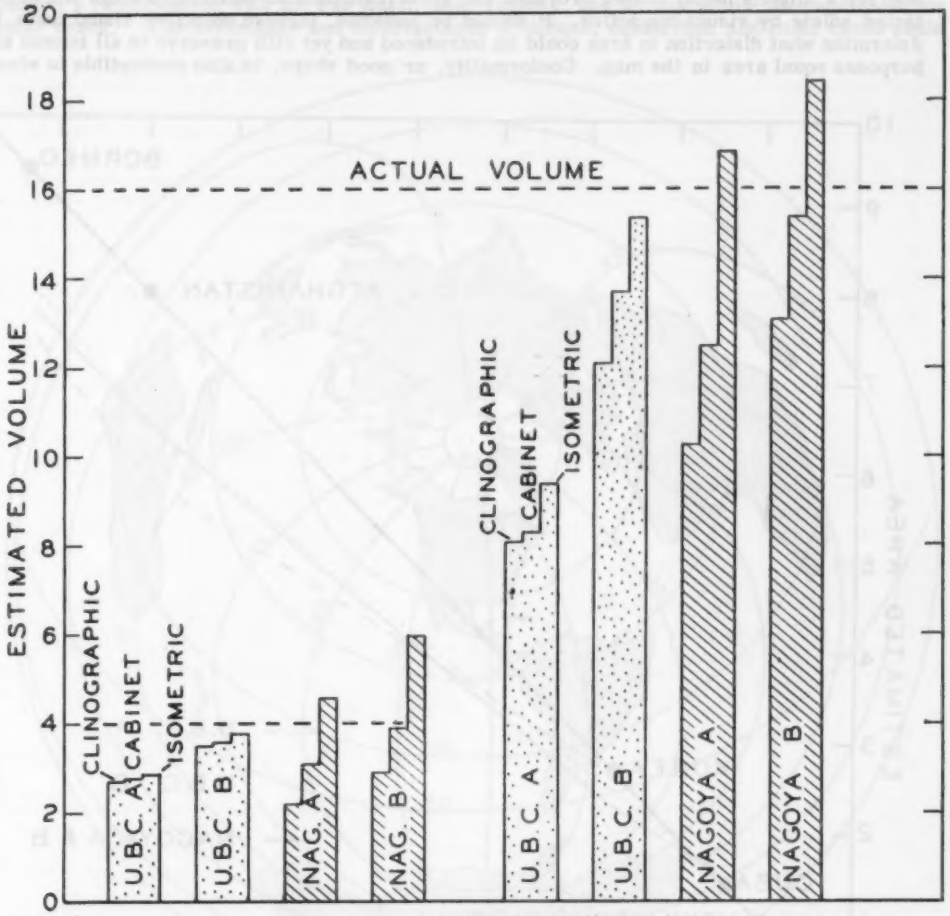

Figure 2. Results of estimation tests of cubic symbols drawn in the clinographic, cabinet, and isometric projections are shown for University of British Columbia students and Japanese students tested by Kanji Kagami of Nagoya, Japan. Groups A and B refer to students without and with cartographic training. Note the similarity of results and the general tendency to underestimate volumes.

Let us consider the experimental approach in its application to the analysis of map projections. For many centuries, mathematicians have been deriving new projections, so that a cartographer now has a whole array from which he can choose one most suited to his needs. Projections today are even being ordered tailor-made, like a suit, for a specific region.[1]

[1] Miller, O.M.: "A New Conformal Projection for Europe and Asia", Geog. Rev., 43, 1953, pp. 405-409.

Nevertheless, little attention has been given to the visual testing of these mathematically derived projections. For instance, as population density is a function of people and area, theoretically areas should be correctly shown on a world population density map.[1] But the areas on such maps are almost never accurately measured although they may be studied intensively. It is doubtful if the average person can detect a 15 per cent areal distortion by eye alone. Since equal areas and good shapes are incompatible on small scale maps, if some areal distortion is tolerated, shapes can thereby be improved. Consequently, it would seem logical for many purposes to sacrifice mathematical equality of area on a world population density map for a slightly better shape, provided the areal distortion so introduced could not be detected solely by visual inspection. It should be possible, through objective visual tests, to determine what distortion in area could be introduced and yet still preserve to all intents and purposes equal area in the map. Conformality, or good shape, is also susceptible to visual

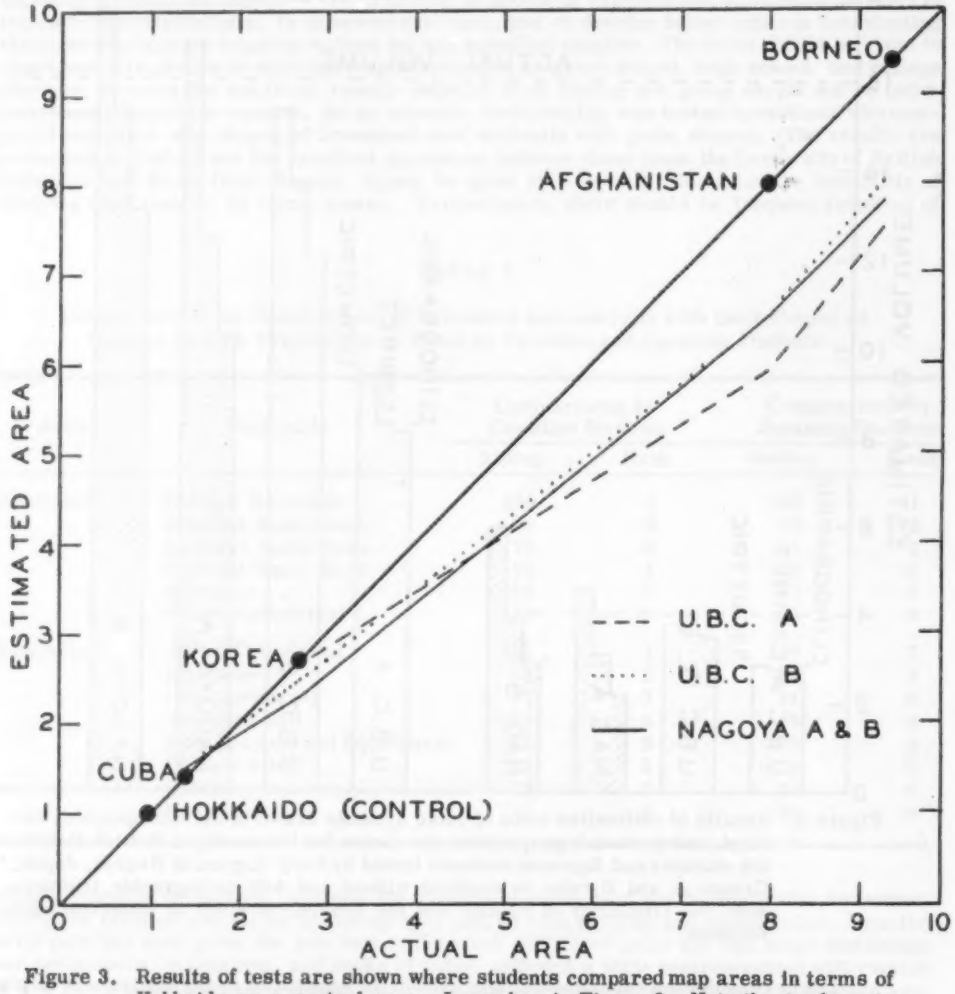

Figure 3. Results of tests are shown where students compared map areas in terms of Hokkaido as a control area. Legend as in Figure 2. Note the tendency to underestimate areas.

[1] McBryde, F. Webster, and Paul D. Thomas: Equal-Area Projections for World Statistical Maps, Coast and Geodetic Survey, Washington, Special Publ. 245, 1949, 44 pp.

tests by comparing map shapes with globe shapes. Another projectional aspect for testing is the use of oblique cases of map projections. Canadian projectional requirements for world maps are different from those of other countries. They are even slightly different from those of the United States, because of our higher latitude and trans-polar relationship with Eurasia. In the common equatorial case of a world map centred on the prime meridian through Greenwich, Canada is tucked away in the top left-hand corner and as a result, her direct relationships with the Far East and the Arctic are obscured. On the other hand, if the map is centred on North America, Canada's relationship with the Far East is brought out, but the trans-polar one is still not improved. For many teaching and study purposes oblique cases would show Canada's relationships with the Far East, polar regions, and Europe better than equatorial or polar cases.[1] The advantages and disadvantages of oblique, equatorial, and polar cases could

Figure 4. The azimuthal equidistant projection, shown here centred at Winnipeg, Manitoba, has certain mathematical properties which could be tested on different groups to see how well they can be visually determined.

[1] The Canadian Oxford Atlas, Oxford University Press, Toronto, 1951, has good examples of the use of oblique cases of Aitoff's projection on pages 16 and A1. The Oxford projection (p. 6 and pp. VI-XI) is an excellent illustration of a compromise projection.

objectively be tested to see how well they bring out desired relationships.[1]

Many other cartographic techniques, such as the use of point, line and areal symbols, lettering, and colouring, need much more experimental investigation. Objective visual testing has much to contribute to cartography, because maps are drawn to be looked at, not to be filed away and forgotten.[2]

THE CARTOGRAPHY OF SPATIAL INTERACTION

A second major field for research is in the cartographic analysis of areal relationships or spatial interactions. This is a dynamic approach to geography for it focuses attention on the interconnections between areas. It stresses interaction. Ullman in his challenging paper entitled "Geography as Spatial Interaction", writes that the dynamic approach focuses "on currents and men and things moving rather than on static descriptions of facilities and areas".[3]

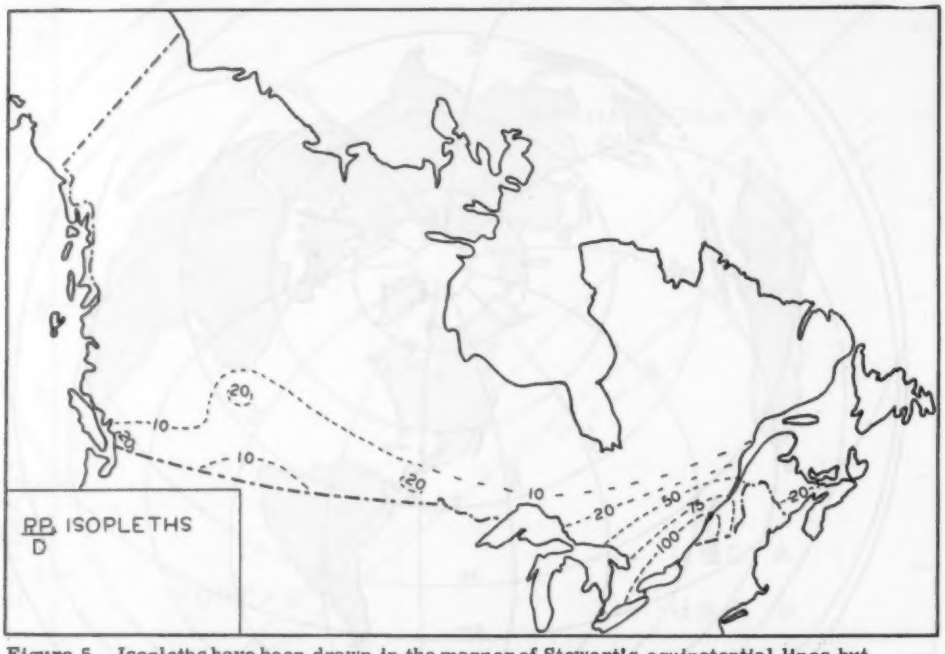

Figure 5. Isopleths have been drawn in the manner of Stewart's equipotential lines but with a different formula. It is obvious that no formula applied to all of Canada, but the P_1P_2/d equation is used only to demonstrate the method. If the formula were exact, the isopleth values would suggest the relative "interactance" or "activity" throughout Canada.

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[1] Robinson, Arthur H.: The Look on Maps, The University of Wisconsin Press, Madison, 1952, 105 pp. On page 69, Robinson discusses several visual tests that could be made on map projections.

[2] Suggestions for visual testing have been made for many years, but few people have conducted them. See, for example, an early reference to testing in; "The 32nd Yearbook of the National Society for the Study of Education", 1933, pp. 403-405.

[3] Ullman, Edward L.: "Geography as Spatial Interaction", paper presented at the 1954 meeting of the Association of American Geographers. Ullman's comment is in reference to a paper by Crowe, P.R.: "On Progress in Geography", Scottish Geog. Mag., 54, 1938, pp. 1-19.

It is a concept which is by no means limited to geography. S.C. Dodd, G.K. Zipf, J.Q. Stewart and others have shown that many relations of society can be expressed in terms of people, distance and time by mathematical formulas.[1] A well known one that has been found to express many interactions, such as the number of automobiles entering a town from a given place,[2] or the intercity movement of people and goods, or the number of students attending the University of British Columbia from Manitoba,[3] is in its simplest for P_1P_2/d where P_1 and P_2 are the populations or some other measure of two places and 'd' their distance apart. For example, intercity travel between Winnipeg and Toronto is likely to be greater than that between Winnipeg and Vancouver, because Toronto is larger and closer to Winnipeg. From this approach, each place in Canada may be said to interact with Winnipeg depending upon its size and distance and we can calculate the total relative influence of them all on Winnipeg in arbitrary units. Stewart has used such an approach to draw equipotential maps showing the potential, influence, or energy of people at a distance on the assumption that every person makes a contribution that is less the farther away he lives. It has been demonstrated that many types of geographic data, such as farmland value per acre and density of rural population are reasonably constant along equipotential lines.[4] Geographers have been somewhat slow in adapting this type of mathematical analysis to geographic problems. As Stewart has expressed it, "Geographers ... ignore this kind of thing almost completely, though geography itself does not. People in certain respects are subject to mathematical rules".[5] Or to quote Ullman, "Focusing research on interaction is new and is increasing. Perhaps now the geographical world is ready to embrace the idea as a fruitful avenue of advance".[6] It is interesting to note that much progress in the study of interactions is being made by European geographers. For example, the Swedish Lund Studies in Geography featured a monograph on "Studies in Rural-Urban Interaction" in 1951.[7] The 1953 paper by R. Ajo on "Contributions to Social Physics, A Programme Sketch with Special Regard to National Planning" has set a high standard for research in the field.[8]

I feel that the study of spatial interactions is a positive approach to many of our national and local planning problems. Even now its methods are being applied to urban and rural planning, highway maintenance, and marketing. The only feasible way to study many interactions is by making detailed statistical and mathematical analyses of economic, social and physical phenomena for mapping purposes, in other words, by using geographic-cartography.[9] In the years to come, I would not be surprised if such studies were to become as important to geographic research as the present analysis of geographic regions.

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[1] Representative publications are: Dodd, Stuart C.: "The Interactance Hypothesis: A Gravity Model Fitting Physical Masses and Human Groups", Am. Sociol. Rev., 15, 1950, pp. 245-256; Zipf, George Kingsley: Human Behavior and the Principle of Least Effort, Cambridge, Mass., 1949; and Stewart, John Q.: "Empirical Mathematical Rules Concerning the Distribution and Equilibrium of Population", Geog. Rev., 37, 1947, pp. 461-485.

[2] State Interest in Highways, A report on highway classification prepared for the Washington State Legislature by the Washington State Council for Highway Research, 1952, 2, pp. 2.2.

[3] The conditions held pretty well for 1952-53 student enrolments.

[4] Stewart, John Q.: "The Development of Social Physics", Am. Jour. Physics, 18, 1950, p. 248.

[5] Stewart, John Q.: "Urban Population Densities", Geog. Rev., 43, 1953, p. 576.

[6] Ullman: 1954, op. cit., concluding paragraph.

[7] "Studies in Rural-Urban Interaction", Lund Studies in Geography, Ser. B., Human Geography No. 3, 1951, 36 pp.

[8] Ajo, Reino: "Contributions to 'Social Physics', A Programme Sketch with Special Regard to National Planning", Lund Studies in Geography, Ser. B., Human Geography No. 11, 1953, 27 pp.

[9] Ullman: 1953, op. cit., pp. 56-57.

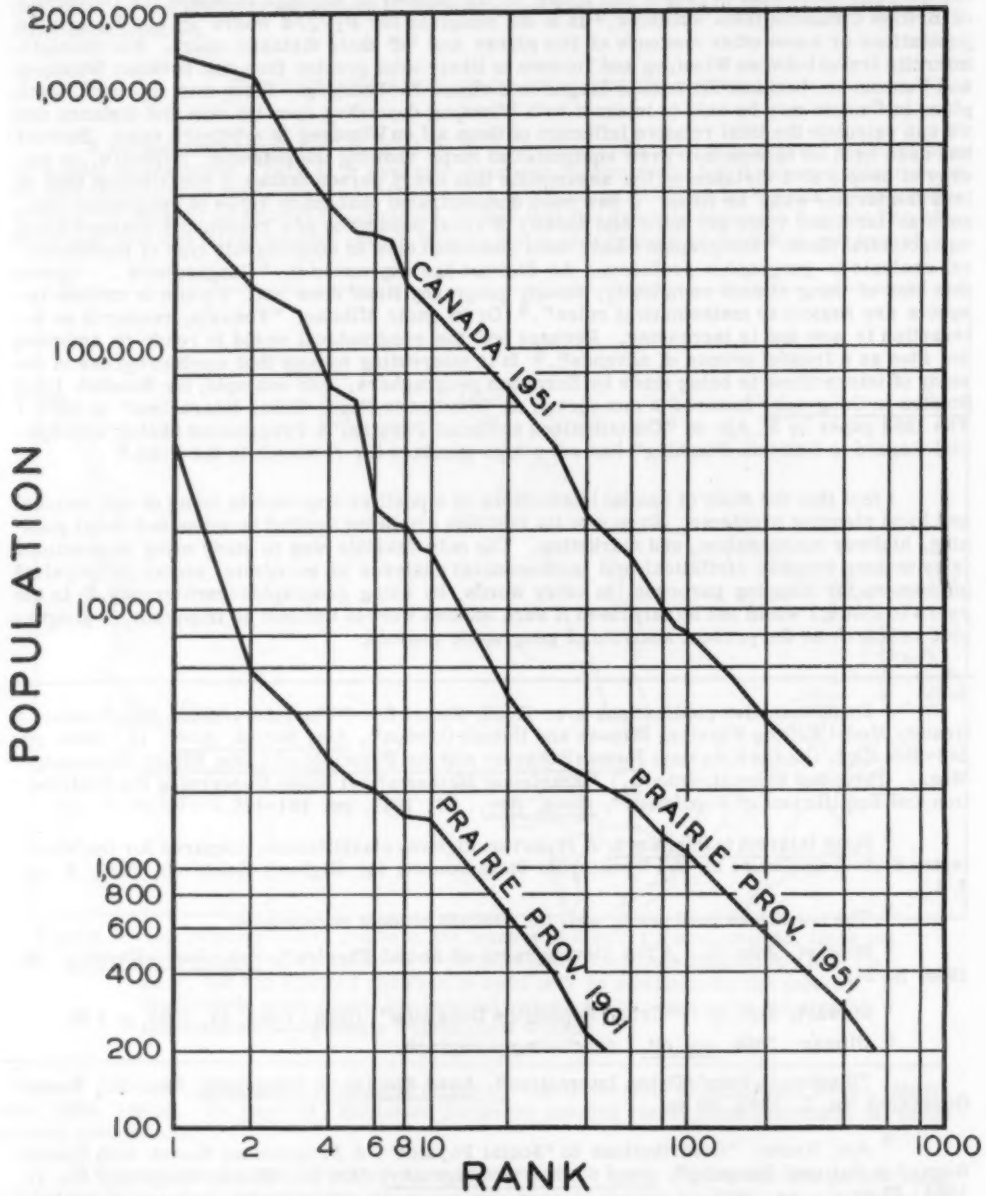

Figure 6. The graph illustrates the approximate straight line relationships for cities when population is plotted against rank on logarithmic paper. This illustration of the Rank-Size rule shows the interdependence of cities, for each city interacts with other areas and falls into a general pattern.

CORRELATION ANALYSIS

A third avenue for cartographic research is in the important field of correlation analysis, because such analysis is based upon cartographic methods.[1] The concept of correlation is a central theme in geography, although words with different shades of meaning such as relationship, interrelationship, or association may be used in its stead.[2] In the words of Griffith Taylor, geography is the correlative science.[3] Without associations or correlations, geography would be but dry statistical bones or a compendium of disconnected facts.

In sciences such as physics and chemistry controlled experiments are possible but in geography it is virtually impossible to isolate factors in order to study individual causes and effects.[4] We cannot double or halve the population of Winnipeg in order to investigate changed density in the rural countryside. Moreover, a high coefficient of correlation may be accidental and spurious as in the example of the membership in the International Association of Machinists that correlated 86 per cent over a considerable period of years with the death rate in the state of Hyderabad, India.[5] Furthermore, a person may unconsciously force his areal mapping to fit his conclusions, or in other ways may invalidate his results.[6] In consequence, even when correlation techniques are available, geographical correlation analysis is often a highly subjective problem.

The statistical theory of correlation analysis is well developed and the techniques used are common to both the social and physical sciences. The basic geographic problem is not the discovery of new methods of correlation, but the adaptation of existing ones to geographic purposes. The need for adaptation stems from the fact that correlation techniques have been devised primarily for data that are arranged according to magnitude, time of occurrence, kind, or degree, rather than geographic location. Although the techniques of geographic correlation analysis are varied, I would like to review a few of the principal ones in order to emphasize some of the cartographic problems involved.

Graphs and diagrams can be used very effectively in correlation analysis, especially in the calculation of coefficients. J.K. Wright, in his penetrating article on "Some Measures of Distribution", has derived from graphic analysis, coefficients of linear and areal distributions specifically designed for geographic research.[7] Although the coefficients have not been widely used, they are, nevertheless, admirably suited to the analysis of the evenness and unevenness of distributional elements. Graphic methods permit the detailed statistical analysis of data and the results can frequently be plotted on maps for the purpose of areal comparisons.[8]

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[1] Many writers have stressed the need for correlation analysis. The fact that correlation analysis needs emphasis at the present time is an indication that the techniques are not too commonly used. See McCarty, H.H.: "An Approach to a Theory of Economic Geography", Economic Geography, 30, 1954, pp. 95-101.

[2] James, Preston E., and Clarence F. Jones, editors: American Geography, Inventory and Prospect, Syracuse University Press, 1954. See the definition on page 4.

[3] Taylor, Griffith: "Geography, the Correlative Science", Can. Jour. Econ. and Pol. Sci., 1, 1936, pp. 535-550.

[4] Martin, A.F.: "The Necessity for Determinism", Transactions and Papers, 1951, The Institute of British Geographers, pp. 4-5.

[5] Cohen, Morris: Reason and Nature: An Essay on the Meaning of the Scientific Method, Harcourt, Brace and Company, New York, 1931, p. 92.

[6] Hartshore: op. cit., p. 329.

[7] Wright, J.K.: "Some Measures of Distribution", Ann. Assoc. Am. Geog., 27, 1937, pp. 177-211.

[8] An excellent illustration of detailed correlation analysis has been given to us by Garnett, Alice: Insolation and Relief, The Institute of British Geographers, London, 1937, 71 pp.

Many correlations are made by drawing and juxtaposing boundaries, a task that is not easy, as every advocate and critic of regionalism well knows. Once boundaries are drawn, they are not easy to correlate or interpret. As Kimble has somewhat facetiously reminded us, "... regional geographers may perhaps be trying to put boundaries that do not exist around areas that do not matter ...".[1] However, it is possible to objectively correlate boundaries by statistical methods even though it is rarely done.[2]

Another method of making correlations is by comparing distributional patterns. The principal means of showing a pattern is by repeating a point symbol, particularly the dot. Dot maps can be compared to see what relationships exist in their patterns. To do so visually is inaccurate, because tests show that visual comparisons are highly subjective.[3,4] Furthermore, what criteria are to be used in deciding visually whether two patterns are similar or dissimilar, or have a high or low degree of correlation? Clearly, quantitative methods are needed, and for this purpose line symbols or isopleths, and area symbols or choropleths, are frequently used.[5] Since isopleths and choropleths always show a relationship, whether a ratio, proportion, average, density, or per cent, isopleth and choropleth values are in every instance a measure of some form of relationship. Probably an isopleth line is the most flexible tool that can be employed for geographic correlation analysis but it should be stressed that the drawing of isopleth lines is more difficult and subjective than the drawing of isometric lines of the contour type.[6]

The preceding brief survey of some of the more important methods of correlation analysis may serve to emphasize two facts: (1) the quantitative study of geographic relationships is an exacting science; and (2) only a few of the standard statistical methods of correlation analysis are directly applicable to geographic research. Many geographers have shown considerable ingenuity in devising ways and means of mapping correlations, but usually the techniques have been subordinate to the overall studies and so have not received the attention that they deserve. Perhaps what is most needed at the moment is a collation of known techniques in order to make them more widely available. There is no comprehensive treatment of geographic correlation analysis in any publication, and yet geographic research avowedly deals in large part with associations and correlations. Geography badly needs more methodological studied on correlation analysis and a deeper infiltration of the principles into geographic writing.

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[1] Kimble, George H.T.: "The Inadequacy of the Regional Concept", London Essays in Geography, Harvard University Press, Cambridge, Mass., 1951, p. 159.

[2] This may be done by a modification of the least square method of interpolating a line through points.

[3] Mackay, J. Ross: "Dotting the Dot Map: An Analysis of Dot Size, Number, and Visual Tone Density", Surveying and Mapping, 9, 1949, pp. 3-10.

[4] Mackay, J. Ross: "Percentage Dot Maps", Economic Geography, 29, 1953, pp. 263-266.

[5] A distinction is made here between isopleths, which are lines of assumed constant value, and isometric lines, which are lines of actual constant value. See, for example, Robinson, A.H., 1953, op. cit., p. 172; and Wright, John K.: "The Terminology of Certain Map Symbols", Geog. Rev., 34, 1944, pp. 653-654. One of the earliest detailed studies on isopleths was: Jones, W.D.: "Ratios and Isopleth Maps in Regional Investigation of Agricultural Land Occupance", Ann. Assoc. Am. Geog. 20, 1930, pp. 177-195. The use of cartographic correlation with isopleths is well illustrated by two articles by Weaver, John C. in the Geog. Rev., 33, 1943, pp. 569-588 and 44, 1954, pp. 175-200.

[6] Mackay, J. Ross: "Some Problems and Techniques in Isopleth Mapping", Economic Geography, 27, 1951, pp. 1-9.

CARTOGRAPHIC TRAINING

Cartography is a rigorous and exacting discipline. It cannot be learned by merely dabbling in it, a fact frequently overlooked by many of those who draw newspaper and magazine maps. All too often, an excellent and factual article is illustrated by an inaccurate and misleading map. Skill with the language of words does not guarantee proficiency with the language of maps. To quote C.H. Deetz:

> "Whoever has a knowledge of cartography is convinced that it is more difficult to compile a good map than it is to write a book. In the latter situation one does not need seriously to torment himself with precision because where ideas fail it is easy to shirk obstacles by the skilful use of words."[1]

This concept is well illustrated by a remark recently made to me: "I wanted to include a map of the principal mining areas in my article, but I did not want to commit myself."

The subject matter of cartography has been the main topic of the 1950 and 1951 Cartography Panels held at the Annual Meetings of the Association of American Geographers[2] and has been the object of investigation by George Jenks.[3] These studies have shown clearly that we must decide at the very outset whether our cartography courses, especially the advanced ones, are to serve the needs of training professional cartographers or to produce better all-round geographers. My own opinion is that we, in Canada, should concentrate at the present time on cartography for geographers rather than for professional cartographers. If for no other reason, this would seem advisable in view of the present limited opportunities for employment in the cartographic field, but conditions may soon change, just as they have changed in the United States. When the national Atlas of Canada is eventually published, it may do much to awaken interest in Canadian cartography.

In discussing the content of cartography courses, it is obvious that no syllabus can ever meet the needs of all geography departments. Some universities do not give a course in cartography, but introduce the principles quite satisfactorily into other courses, especially during laboratory sessions.[4] Some give cartography courses, but call them by other names, such as Practical Geography, as is done, for example, at McGill University.

The content of an introductory course in cartography should, I believe, include approximately the material covered in either of the textbooks by Raisz or by Robinson. However, I feel that too much time should not be spent on the construction of map projections. "The cartographer needs more training in how to choose and use projections than he does in how to calculate and construct them".[5] An introductory course should be given early in the student's geographic training for only by that means can his cartographic knowledge be applied in later studies. Cartography by itself is sterile. Most universities have found also that cartography courses are popular with students in other disciplines, and so perform a service function in the college curriculum.

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[1] Deetz, Charles H.: Cartography, Coast and Geodetic Survey, Washington, Special Publ. No. 205, 1943, p. 1.

[2] Meetings held in 1950 and 1951. See the Cartography Issues of The Professional Geographer, 2, 1950, and 3, 1951.

[3] Jenks, George F.: "An Improved Curriculum for Cartographic Training at the College and University Level", Ann. Assoc. Am. Geog., 33, 1953, pp. 317-331.

[4] For example, a great deal of cartographic material would be covered in any courses that followed Taylor, Griffith: The Geographical Laboratory, University of Toronto Press, 1942, 114 pp.

[5] Robinson, Arthur H.: "University Training for Government Cartographers", The Professional Geographer, 3, September, 1951, p. 5.

There is more difference from university to university in the material taught in advanced cartography courses than in introductory ones. I believe this is due largely to the lack of an advanced textbook and to the youth of cartography, inasmuch as both factors should contribute substantially to a lack of uniformity. What is needed now is a good advanced cartography book. When one is written, it seems reasonable to expect that many more advanced courses will be offered.

For advanced work in cartography students should have a good grounding in statistics and mathematics. It might be worthwhile emphasizing that similar training is also indispensable for much advanced work in such subjects as climatology, economic geography, and even urban geography. In addition, thorough training should be given in photo interpretation and the elements of photogrammetry.

At the present time many universities that grant M.A. and Ph.D. degrees in geography will accept theses on cartographic subjects, although they account for less than one per cent of all geography theses in either the United States or Canada. No university in Canada and only Ohio State University in the United States, grants a Ph.D. in cartography as separate and distinct from other subjects, including geography.

Ideally, it would be desirable for college geography, and probably for high school geography as well, if more fundamental cartographic training were introduced into high school courses. This applies especially to the interpretation of topographic maps, as practised in Great Britain. In addition, aerial photographs might be introduced into high school studies to great advantage.

CONCLUSION

In conclusion, I have tried to discuss cartography from the viewpoint of the geographer. Because cartography is a young subject in the geography curriculum, perhaps it is now time for stock-taking, for a glance back, and a look ahead.

It is quite evident that the general trend in the social sciences is towards more precise and accurate studies. The path is rough and rocky but its direction is certain. Cartography can help to smooth the road of geographic progress in at least three important ways: (1) by means of objective visual testing of cartographic techniques in order to provide a better understanding of the look of maps; (2) by cartographic research into the problems involved in the geography of spatial interactions; and (3) by developing improved cartographic methods of correlation analysis. All three ways will lead to greater precision in the mapping and interpretation of geographic relationships.

There is a serious need for more methodological studies and advanced research in cartography. In particular, I feel that graduate students should be encouraged to undertake cartographic research with special reference to Canadian problems.

As geographic specialization has gradually developed through the years, many topical branches have evolved.[1] But the analytical techniques in use differ little, because each branch deals essentially with the same type of geographic problem, which is the arrangement and associations of things, whether landforms or people. It would then seem to be an economy of effort and sensible organization to include in cartography those methods and techniques which form the common denominator of geographical analysis. To do so would strengthen geography by making cartography fulfil its logical role in geographic training and research.

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[1] James and Jones: op. cit., see table of contents where over twenty branches are listed.

APPLIED GEOGRAPHY IN BRITISH COLUMBIA

A. L. Farley

Surveys and Mapping Branch, British Columbia Lands Service

The recency of development of applied geography[1] in British Columbia, as indeed through the nation as a whole, is immediately apparent and is attributable to two closely associated things. First, it suggests that geography as a field of specialization is relatively new on this continent. Second, it reflects the fact that in the post-war expansion of geography, especially in Canada, most of the graduates were absorbed into academic and teaching positions and few were available to seek employment in other circles. Within the past four or five years, however, the supply of trained graduates has filled the immediate demand at the academic level and small but increasing numbers of geographers have sought positions in government and industry. Openings for geographers, as such, in industry and government were virtually non-existent and these graduates obviously faced the task of "selling" geography and geographers to potential employers who knew little or nothing about the field. Success in this task of employer education is slow and can only be met through a continued record of successful performance. The achievement in this direction is attested by the significant number of geography graduates across the country who are now employed in government and industry. Government has absorbed the greatest share of these graduates partly because the scope of activities associated with government frequently presents openings for workers in both the physical and the social sciences. Industry on the other hand, has a restricted range of activities and caters more to the specialist. This is not to suggest that there is little place for geographers in industry, indeed it seems to offer a major potential for employment. What is suggested is that students desiring to work in the industrial field should shape their programme toward that ultimate goal. Summer employment with industry is one of the best means through which a student may not only gain some degree of specialty through first hand experience, but also pave the way for his future employment. Perhaps this is a statement of the obvious, but in a field as recent as applied geography it seems imperative, at least at this stage in our development, that the graduate prove to his employer what sorts of contributions geographers can make that would be useful to him.

BEGINNINGS IN BRITISH COLUMBIA

In British Columbia, applied geography began in 1947 with the temporary appointment of a geographer to the provincial Land Utilization Survey. Today in the Province there are nine graduate geographers working in the applied field. Of the nine, four are with the Provincial Government, one is with the Lower Mainland Regional Planning Board, (a Provincial-Municipal agency), one is with the Dominion-Provincial Board Fraser River Basin, one is working as a geographic consultant, and two are engaged in business and industry.

My association with the field of applied geography has been as Geographer with the Surveys and Mapping Branch, British Columbia Lands Service, an appointment which began in July, 1952. Within the scope of this paper I shall discuss some aspects of the applied studies with which I have been associated, and indicate some of the contributions that a geographic training can make in approaching them. It should be stated at the outset that few government agencies are interested in "geographic problems" as such. Their interest lies primarily with the practical aspects of a given problem and the solution to it. But whether or not the emphasis is upon the practical, the tools of geographic research and the methodology used in approaching the problem are the same. Further, a consideration of theoretical aspects is often found essential to an understanding of the practical.

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[1] For the purposes of this paper the term "applied geography" refers to the application of professional geographic training beyond the sphere of the university to the geographic problems of a particular area.

LANDS SERIES BULLETINS

One of the first projects to be undertaken for the Lands Service was a revision of the Lands Series Bulletins. These are a series of booklet-form reports with an agricultural bias, intended to acquaint incoming settlers with conditions in different areas of the province. The existing bulletins were out of date, of poor design, and varied in quality of content.

In approaching the revision, the first task was one of examining and revising the areal coverage of the bulletins. It was decided that a regional approach to the areal coverage would be desirable. This would permit a logical arrangement of the bulletin areas, it would facilitate the gathering and the presentation of data and it would make each bulletin area a more meaningful unit to the reader. The development in outline of the regions, or more correctly "compages", of British Columbia was an interesting and necessary phase of this work, involving a good deal of thought on the concept of regions. As might be expected, the hierarchy of compages had to be meshed with existing, well-established administrative districts and geography suffered somewhat in the compromise. But the geographic approach resulted in the bulletins being placed on a more meaningful areal basis and reduced their number from over thirty, to ten - a substantial saving in the cost of printing.

The gathering of information for the new bulletins involved both library research and field investigation. Particularly in connection with field work, a background in geographic techniques proved very useful. A series of questionnaires and field check-lists were prepared, some to be used for guiding field observation and in interviewing district officials. Others were designed for mailing to postal authorities, civic officials and business organizations throughout the province. As a result of the application of these elementary techniques, a considerable volume of up-to-date information has been acquired which will serve not only the immediate purpose of the bulletins but as a permanent reference for other phases of applied geography. From the practical standpoint, the development and use of questionnaires and field check lists has reduced the time required in the field, thereby effecting a substantial saving in production costs.

In organizing and preparing the content of each bulletin, the maintenance of the geographic viewpoint - of seeing things together in their spatial relationships - has proven invaluable. By maintaining this viewpoint, an effective word picture can be built up which has wide application not only to the prospective agricultural settler but also to those interested in business or industrial activity. Other stages of bulletin preparation can be facilitated by a knowledge of cartography and cartographic techniques. This is particularly true in the choice and design of accompanying maps. A background knowledge of the preparation of copy for lithography and of lithographic methods is necessary to effective choice, with limited funds, in such matters as colour, layout and type.

DISTRIBUTION MAPS

Another phase of work for the British Columbia Lands Service is the development of a series of maps showing different distributions within the province. Though still largely experimental it is hoped that this work will lead to an atlas of British Columbia which will be of use in administrative circles, to educators and to the general public. In determining the choice of scale, the kinds of distributions to be shown, the methods of portraying these and the means of reproduction, a knowledge of geography and particularly of cartography is prerequisite.

As a first step it is planned to map landforms cover, population distribution, precipitation and mineral resources. These will be designed as overprints on existing or proposed map bases making for both convenience and economy. It should be noted that the preparation of the overprints is a matter involving a good deal of time and of original work, since few such distributions have ever been attempted for British Columbia. The first of these maps to be undertaken is a landforms representation employing a modified Raisz technique. It will appear as an overprint on map 1E (Figure 1A), one of a new series of base maps for the province, at a scale of ten miles to the inch. Figure 1B is a reproduction of part of this map. Mr. Howard

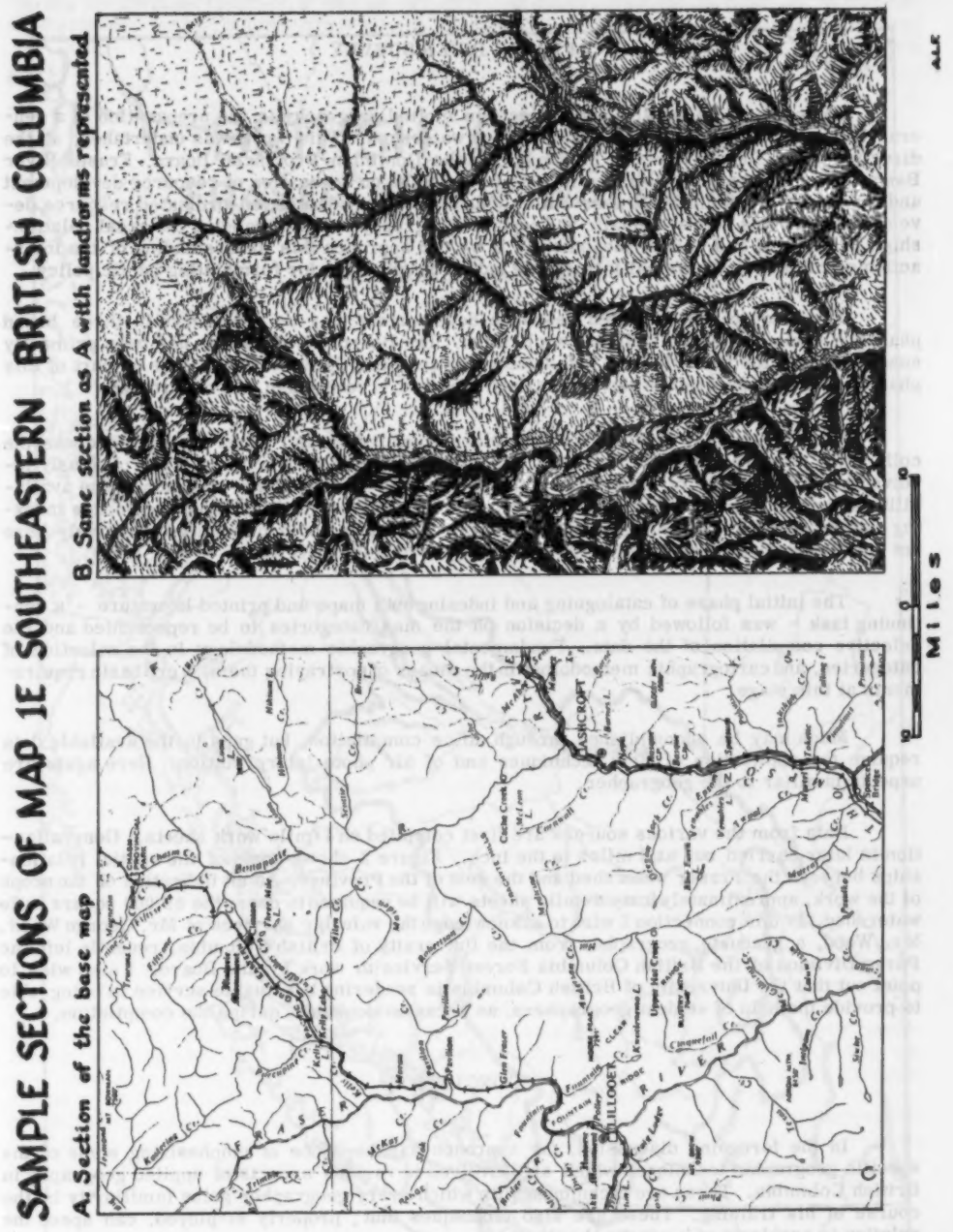

Figure 1.

DETROIT PUBLIC LIBRARY

Davis, an artist-draughtsman on the Surveys and Mapping staff carried out the landforms compilation. Aerial photographs were used very extensively in this work, as many as 1,500 being consulted in a single day.

FRASER RIVER SURVEY

One of the most challenging projects in applied geography is the preparation of a general land use-cover map of the Fraser River watershed. This work was undertaken, at the direction of the Deputy Minister of Lands, for the Dominion-Provincial Board, Fraser River Basin. The Board was established in 1948 to study the co-ordination of resource development and flood control within the Fraser watershed. By its very nature, co-ordinated resource development involves both systematic and regional geography in understanding the areal relationships of physical and human phenomena. If we can approach this understanding of the interaction of cultural and physical factors, we have a sound basis for formulating public policy.

The study of co-ordinated resource development may be considered in three broad phases - compilation, analysis and application. The Board's work so far has been primarily concerned with the first of these - the gathering and compilation of data. It is as part of this phase that the preparation of the generalized land use - cover map was undertaken.

Work on the map involved several closely related tasks. First among these was the collection, examination and cataloguing of all available map information. This obviously involved some knowledge of map scales, projections and various other map data. The availability of written literature had also to be determined and a practicable cross-reference indexing system adopted. Training in library research methods could be applied effectively here not only in locating references but in evaluating the usefulness of each.

The initial phase of cataloguing and indexing both maps and printed literature - a continuing task - was followed by a decision on the map categories to be represented and the selective compilation of the data. Fundamental geographic methodology in the selection of categories, and cartographic methodology in the means of portraying them, were basic requirements at this stage.

Much may be accomplished through office compilation, but gaps in the available data require the application of field techniques and of air photo interpretation. Here again are aspects familiar to the geographer.

Data from the various sources are first compiled on 4-mile work sheets. Generalization is later carried out at 8 miles to the inch. Figure 2 shows some of the spatial relationships between the Fraser watershed and the rest of the Province. As an indication of the scope of the work, approximately forty 4-mile sheets will be required to cover the 89,000 square mile watershed. In this connection I wish to acknowledge the valuable services of Mr. George Wood. Mr. Wood, a graduate geographer from the University of British Columbia, recently left the Parks Division of the British Columbia Forest Service to work for the Board. I also wish to point out that the University of British Columbia is rendering a valuable service in being able to provide the help of student geographers, as occasion demands, during the compilation.

CONCLUSION

In the foregoing discussion, my approach has been one of emphasizing some of the specific geographic techniques which are involved in various aspects of applied geography in British Columbia. These are techniques with which every geographer gains familiarity in the course of his training. These are also techniques that, properly employed, can speed the solution to problems of a practical nature.

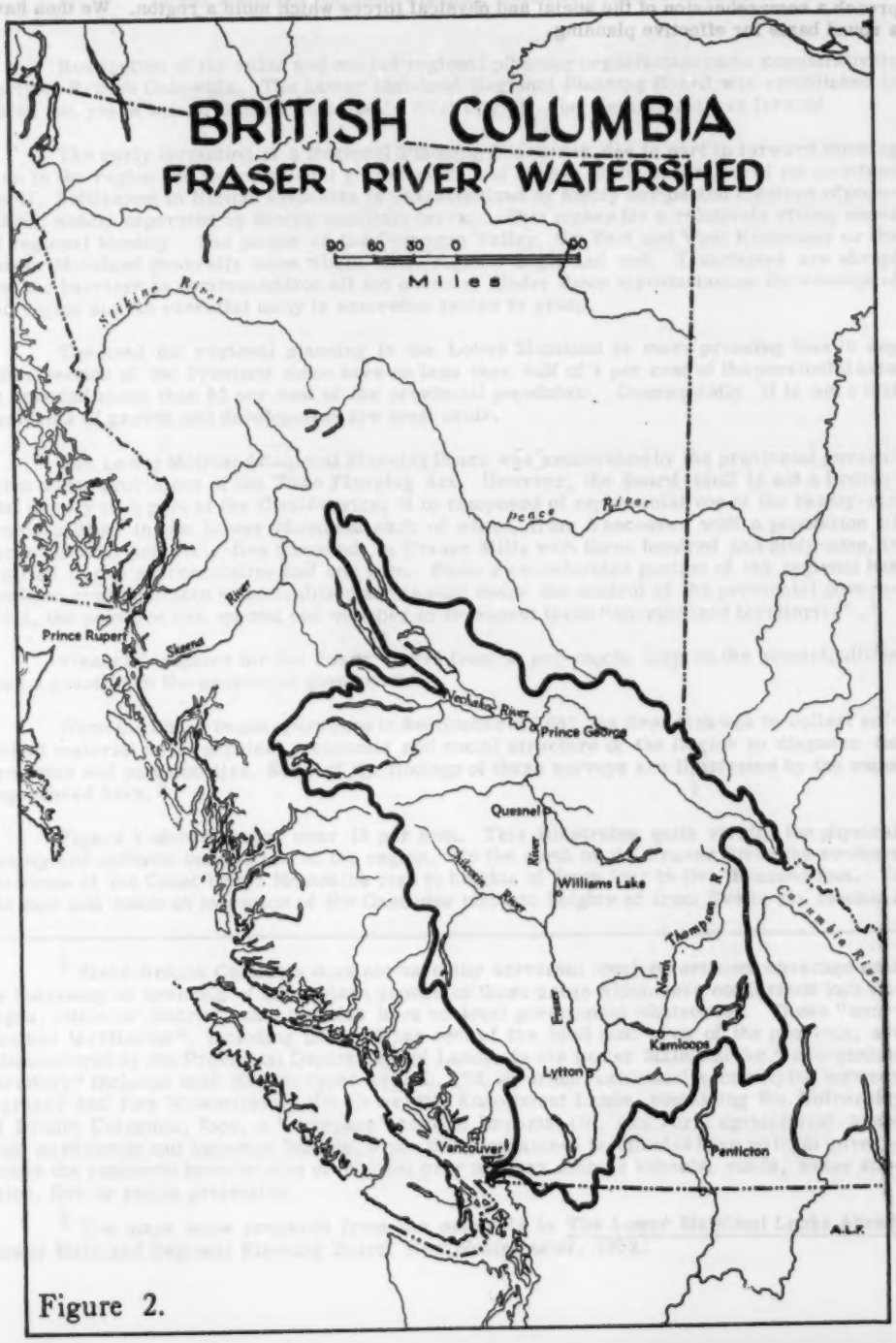
BRITISH COLUMBIA
FRASER RIVER WATERSHED
90 60 30 0 90
Miles
Stikine River
Peace River
Skeena River
Prince Rupert
Nechako River
Prince George
Quesnel
Chilcotin River
Fraser River
Williams Lake
North Thompson R.
Columbia River
Kamloops
Lytton
Vancouver
Penticton
A.L.E.

Figure 2.

I do not, however, wish to imply that a familiarity with specific techniques alone constitutes applied geography. A working knowledge of the separate systematic geographies is also essential. Finally, there is in applied geography, a need for the regional concept, especially in the field of resource planning. With the benefit of regional analysis we can approach a comprehension of the social and physical forces which mold a region. We then have a sound basis for effective planning.

PLANNING IN THE LOWER MAINLAND REGION OF BRITISH COLUMBIA

A.D. Crerar

Lower Mainland Regional Planning Board of British Columbia

Realization of the value and need of regional planning organization came comparatively early to British Columbia. The Lower Mainland Regional Planning Board was established in 1950, two years before British Columbia's first city planning department was formed.

The early formation of a Regional Planning Board was due in part to forward thinking men in the region and the provincial government, and in part to the geography of the province itself. Settlement in British Columbia is characterized by highly compacted clusters of population, widely separated by sterile mountain terrain. This makes for a relatively strong sense of regional identity. The people of the Okanagan Valley, the East and West Kootenays or the Lower Mainland generally know where their regions begin and end. Transitions are abrupt and the barriers to communication all too obvious. Under these circumstances the concept of the region and its essential unity is somewhat easier to grasp.

The need for regional planning in the Lower Mainland is more pressing than in any other section of the Province since here on less than half of 1 per cent of the provincial area is crowded more than 52 per cent of the provincial population. Consequently, it is here that problems of growth and development are most acute.

The Lower Mainland Regional Planning Board was established by the provincial government under provisions of the Town Planning Act. However, the Board itself is not a Provincial agency or a part of the Civil Service. It is composed of representatives of the twenty-six municipalities in the Lower Mainland each of whom, from Vancouver with a population of three hundred and forty-five thousand, to Fraser Mills with three hundred and sixty-nine, is entitled to one representative and one vote. Since a considerable portion of the regional has not been organized into municipalities and is still under the control of the provincial government, the province can appoint one member to represent these "unorganized territories".[1]

Financial support for the Board comes from a per capita levy on the municipalities plus a grant from the provincial government.

When the Board began operations in September of 1950, its first task was to collect sufficient material on the physical, economic and social structure of the Region to diagnose its problems and potentialities. Some of the findings of these surveys are illustrated by the maps reproduced here.[2]

Figure 1 shows slopes over 15 per cent. This illustrates quite vividly the physical reality and definite boundaries of the region. To the north of the Fraser River the southern terminus of the Coast Range Mountains rise to heights of from four to five thousand feet. To the east and south an extension of the Cascades rises to heights of from five to six thousand

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[1] Since British Columbia does not have any universal local government coverage such as the county or township of the eastern provinces those areas which have not formed into villages, cities or district municipalities have no local government whatsoever. These "unorganized territories", including about 95 per cent of the total land area of the province, are administered by the Provincial Department of Lands. In the Lower Mainland the "unorganized territory" includes such diverse types as D.L. 172, an urban residential section lying between Burnaby and New Westminster, the University Endowment Lands, containing the University of British Columbia, Ioco, a "company" town of Imperial Oil, and rural agricultural areas such as Nicomen and Barnston Islands. Since the unorganized territories have no local governments the residents have no vote or control over matters such as schools, roads, water supplies, fire or police protection.

[2] The maps were prepared from the originals in The Lower Mainland Looks Ahead, Lower Mainland Regional Planning Board, New Westminster, 1952.

Figure 1. The distribution of steep slopes in the Lower Mainland of British Columbia.

feet. Eastward the only outlet from the Region is the mile-wide canyon of the Fraser River. To the west is the Gulf of Georgia and to the south the International Border. Though the delta of the Fraser extends south into the United States for a considerable distance, the International Border in an economic, social and political sense is probably as effective a barrier as are the mountain ranges to the north and east.

The slope map shows the limits of the region. It also depicts the first restriction on the use of land. In the Lower Mainland it is believed that slopes above 15 per cent are unsuitable for agriculture, while those above 20 per cent would be extremely costly to service if used for residential purposes. From the agricultural viewpoint, eight hundred and ten square miles of the region are unusable, and most of this area would be difficult to use for residential purposes. Only some seven hundred and ninety square miles are left which can be considered fully usable from the topographic viewpoint.

Not all of the topographically suitable soils are of equal value for agricultural use. Figures 2 and 3 show the areas of good and medium quality soils. A comparison of the map

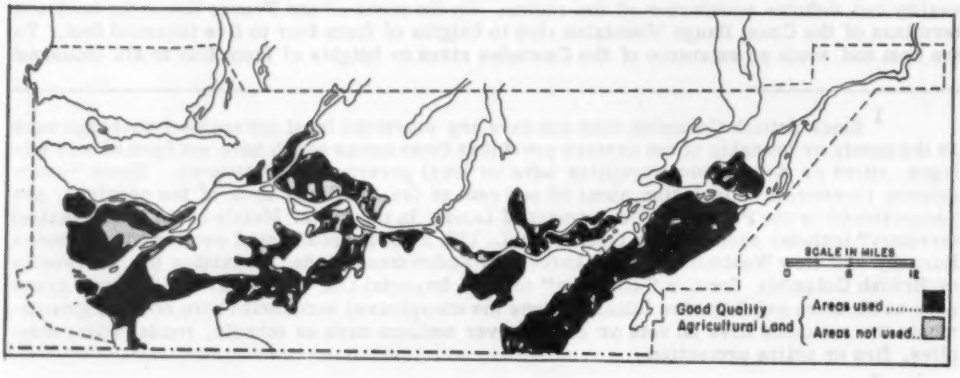

Figure 2. The distribution of good agricultural land in the Lower Mainland of British Columbia.

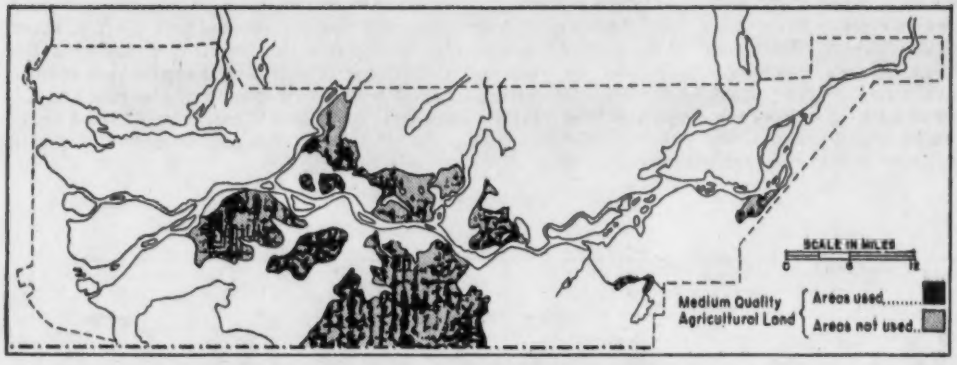

Figure 3. The distribution of medium quality agricultural land in the Lower Mainland of British Columbia.

of the good quality soil with the map of the dyked land (Figure 4) shows the extent to which the Lower Mainland is dependent upon the dyked and drained land of the recent delta for its better-quality agricultural soils.

The only major areas of poor agricultural soil behind the dykes are the deeper peat bogs, found mainly in the western part of the region.

Because of the difficulty of economical reclamation, a dyked area of some six thousand acres bordering the east bank of the Pitt River was classed as a medium quality soil in the Board's original survey. Several attempts had been made in the past to bring this land into production, but they all met with failure. In 1952 however, a Dutch land company, Pitt Polder Limited, purchased the area. By using Dutch dyking and drainage techniques they have succeeded in bringing two thousand acres into production to date. Thus the application of more efficient methods has permitted the utilization of the last remaining empty area of dyked land and has transformed an area of medium quality soil into one of good quality.

The major areas of medium quality soils are found, however, in the till uplands. Here the lower quality is due to the lack of drought resistance of the soils rather than engineering problems connected with dyking and drainage. The till uplands rise rather abruptly from the recent delta to heights of from three hundred to nine hundred feet. Their topography varies from rolling to hilly.

The contrast between the recent delta and the glacial upland is not only physical, a distinct contrast can also be seen in their pattern of utilization. Figure 2 shows the almost complete utilization of the good quality lowland soils, with approximately 85 per cent of the land in use. From Figure 3 it can be seen that the utilization of the medium quality upland soils is characterized by a more lineal pattern, fringing the north-south, east-west roads. On these soils about 40 per cent of the land is in use.

This contrast in utilization is not due primarily to the difference in soil quality, since both are extremely productive, though, of course, yields are higher on the better grade soils. The contrasting utilization pattern is dependent to a greater extent upon the differing original vegetation cover. In the lowland areas, before dyking, the original cover was largely marsh grass and ferns. (Hence the common suffix "prairie" is still applied to many lowland agricultural centres such as Langley Prairie, Hatzic Prairie, Matsqui Prairie, etc.) After dyking such land required only drainage and cultivation to bring it to a high state of productivity.

The upland areas, however, were covered originally by heavy coastal forests, with Douglas fir (Pseudotsuga taxifolia) the dominant species. Even when logged off, around the

turn of the century, the gigantic stumps left behind by the logging operation made the task of clearing slow and costly. Only a few acres could be cleared in a year and consequently the small cleared areas were generally put into high value cash crops, such as strawberries and raspberries. Even today, with heavy equipment, clearing costs in the uplands start at about $200 per acre. Settlement in the upland areas generally begins with a small clearing near the road which is extended outward year by year and a multitude of such small operations results in the fringe-like pattern on the utilization map. Faced with the problems of clearing and the need for high value cash crops the single family farm unit finds that it can only utilize a relatively small-sized farm, consequently the population density on the poorer upland soils is greater than in the fertile lowland areas.

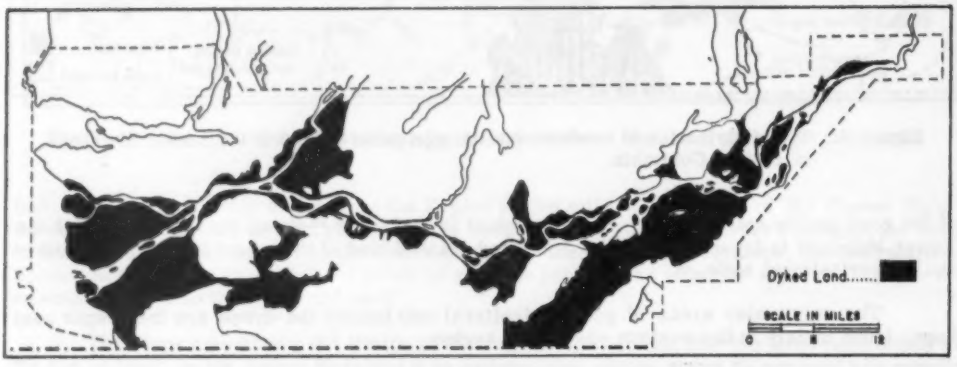

Figure 4. The distribution of dyked land in the Lower Mainland of British Columbia.

In addition to the mapping of various aspects of the region, statistical analyses were undertaken of the prospects of the basic industries and the probable population growth. These studies lead to the conclusion that a population of one million and a half could be expected in the region by the year 2,000 A.D. The population of the region in 1951 was six hundred and forty-three thousand, with the Greater Vancouver Metropolitan Area accounting for five hundred and twenty-one thousand. The population increase of over 100 per cent was based mainly on the logistic projection of past trends. This method is often open to error. However, the Lower Mainland for the past three decades has consistently represented somewhat over 50 per cent of the provincial population, and with a group of this magnitude the logistic projection has considerable validity, particularly since there is little reason to expect a change in the ratio between the region and the province.

With this population growth expected the major problem facing the region then became clear. How can this greatly increased population be accommodated in a region where areal expansion is virtually impossible?

It was decided that priorities for the use of land would have to be assigned. The first priority was given to land for industrial purposes, since industrial growth will be the base for further development of the region. The land requirements of industry are also very exacting, and, if potential industrial land were to be used for other purposes, suitable additional areas would be very difficult to find.

The second priority was given to land with recreational potential. Recreational land also has rigid requirements and once used for other purposes, is very difficult to restore.

The third priority was given to land for agricultural use. Expansion of the agricultural land of the region is impossible, because of the barriers which so neatly delimit the region. The nearest considerable area of agricultural land is found in the Okanagan Valley, four hundred miles away. Within the region, the first class agricultural land is almost completely

occupied. Complete development of the upland soils could probably bring about an expansion of the agricultural area by 50 per cent. But, a population increase of over 100 per cent is expected within the next fifty years. With better farming methods agricultural productivity can probably be increased to fill the gap. However, if first class land continues to be removed from agricultural use by residential sprawl, the region will find itself less and less able to maintain a local supply of several major agricultural products, particularly milk.

If the only reason for preserving land in agricultural production were to protect a local food supply, it is improbable that much could be done to prevent the use of agricultural land for residential purposes, since it is quite true that the region can not feed itself at present, and that sufficient supplies will always be available at a higher cost to cover transportation charges. There are, however, a number of other reasons (with greater popular appeal than regional altruism) why the region's first class soils should be preserved for agricultural production.

(1) Almost all of these lands are dyked. There can be no final guarantee that the dykes will always be sufficient to contain a mighty and capricious river, such as the Fraser, and the damage to life and property that could result from flooding is obviously much greater in a residential than in a farming community. (2) The lowlands present a number of problems of drainage and sewerage that would be expensive to overcome if they were to be used for residential purposes. (3) Sprawling residential development requires greater municipal expenditures for roads and other services than does compact development.

For these reasons and several others it is hoped that residential expansion on the first class agricultural lands can be slowed. Detailed examination of this question is being undertaken at present. It will not be possible to bring it to a halt; the expansive forces are too powerful; but if development is directed toward the consolidation of growth in areas where subdivision and the breakdown of farm structure has already begun, it is believed that the municipalities could benefit by lower costs for municipal services, and the region could benefit by slowing the loss of farm land.

The material gathered by the Board and the conclusions it had reached were presented in a report to the municipalities entitled "The Lower Mainland Looks Ahead". It contained a number of specific recommendations which charted the future actions of the Board. The recommendations included the following

"That the Federal Department of Transport be requested to establish a system of meteorological stations in the Lower Mainland Region as a basis for future studies of climate".

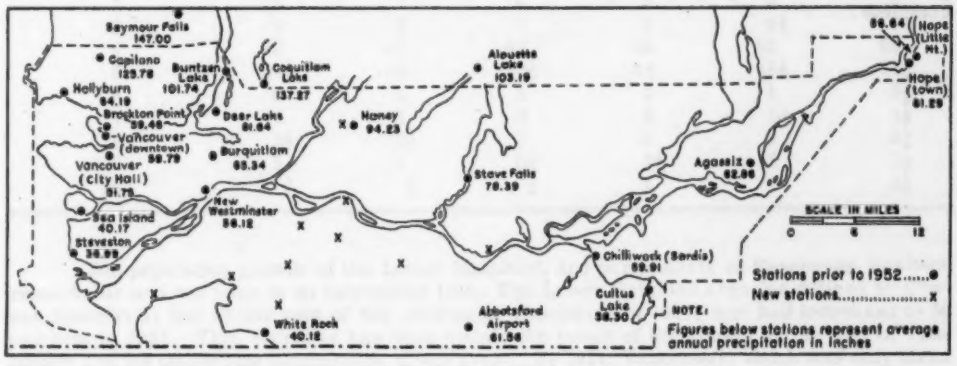

Figure 5. Climatic stations and average annual precipitation in the Lower Mainland of British Columbia.

Figure 5 shows the network of stations reporting climatic observations that existed in the valley prior to 1952. Precipitation in the region increases rapidly both from south to north and from west to east. For example, from Steveston to Capilano precipitation increases from thirty-seven inches to one hundred and twenty-six inches in a distance of nineteen miles. From west to east precipitation increases from forty inches at White Rock to sixty-two inches at Agassiz about sixty miles away. Accurate precipitation statistics have become very necessary because of the increasing use of irrigation in the valley to overcome the restrictions on plant growth during the summer drought. The new climate recording stations, which are located by crosses on the map, are primarily intended to give a more accurate picture of precipitation gradients throughout the region. They were selected by the Board's staff in conjunction with meteorologists of the Department of Transport.

A recommendation was made "That the Department of Lands and Municipal Affairs should be asked to prepare legislation to give municipalities more control over the subdivision of land". That has been done and a subcommittee of the Board is working on a model subdivision control bylaw that will allow municipalities to control the indiscriminate subdivision of land.

A recommendation was made that "The Regional Planning Board should prepare a plan in collaboration with the Department of Transport for the development of a system of airports in the Region". Such a report has been made.[1]

A recommendation that the "program of the Regional Planning Board should be broadened to include direction and assistance of local planning activities" has been carried out. This is probably the most important of the Board's recommendations, for, though the Board has authority to plan for the region, there is no regional government organization to carry out the Board's recommendations. By instituting planning on the local level the Board can, municipality by municipality, put into practice the regional principles mentioned previously. Work at the local level has begun in three municipalities and more will be included as time and staff permit.

Examination has also been made of the problem of metropolitan organization. The Board's reports on parks and airports both point to the need for some form of metropolitan co-ordination to tackle necessary tasks that are too large for individual municipalities. At present a committee of the Mayors and Reeves of the metropolitan community have begun a thorough examination of this question with the assistance of the Regional Planning Board.

This list does not exhaust the scope of the Board's activities and findings. No mention has been made of the Board's studies of the highway and bridge problem, the regional house-numbering scheme or the preparation of a model building code. Emphasis has been placed throughout on those portions of the Board's program and materials that were thought to be of greatest interest to geographers, and the picture of the Board's activities is by no means complete.

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[1] Crerar, A.D.: Airports for the Lower Mainland; Lower Mainland Regional Planning Board, New Westminister, 1953.

POPULATION TRENDS AND DISTRIBUTION IN BRITISH COLUMBIA

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POPULATION TRENDS, 1901 - 1951

British Columbia has taken pride in being Canada's fastest-growing province, by percentage, for the past three decades. In each of the last three census years, 1931-51, British Columbia grew at a rate which was about twice the Canadian average. This growth rate has been very greatly the result of starting with a small population in comparison with the greater numbers in Eastern Canada. From 1901 to 1951 British Columbia increased in numbers from 178,000 to 1,165,000 - that is, it increased by about one million persons. This 50-year increase is, however, only a little more than was added to the population of Ontario in the last ten years. We have been so impressed with our rapid growth on the West Coast that we forget that there are more people in the one city of Montreal than there are in all of British Columbia.

The population growth of British Columbia has not been spread evenly over the province. The first major centres of population were in the southwestern corner, and this area has continued to have the main concentration of people. In 1901 the Lower Fraser River Valley and Vancouver Island of the southwestern area, each had about 30 per cent of the provincial population. These two regions have continued to increase until together they had 75 per cent of the British Columbia population in 1951. The rate of growth, however, has been much greater on the Lower Fraser River mainland than on the Island. As the following table shows, Vancouver Island's percentage of the provincial population dropped markedly in 1911 to 20 per cent, and has declined since then to about 18 per cent, although actual numbers on the Island increased. Growth has been confined chiefly to the southern tip of the Island - in the Victoria area - and along the southeast coast.

TABLE I

Percentage of British Columbia Population in each Census Division, 1901-51

	Year					
Census Division	1901	1911	1921	1931	1941	1951
1	4½	6	3½	3½	2½	2
2	13	7	6	6	6	5
3	7	7	7	6	6½	7
4	30	47	49	54	55	56
5	29½	20	20½	18	18½	18½
6	6	5	5	4	4	3½
7	2	1	2	2	1½	1½
8	2½	2½	3	3	3	3½
9	5	4	3½	2½	2	1½
10	½	½	½	1	1	1½

The population growth of the Lower Mainland, and particularly of Vancouver, has been remarkable and has been at an increasing rate. The Lower Mainland area (as defined by Census District 4) had 47 per cent of the provincial population in 1911, and had increased to 56 per cent in 1951. This increase has been mainly the result of the growth of the City of Vancouver and its immediate surrounding urban areas. By 1911, Vancouver, which was only about 20 years old, had experienced one of the most remarkable assembling of people that Canada had seen. The city rose to become Canada's fourth largest city. Its population of 100,000 in 1911 was greater than most Eastern Canadian cities that had been established for many decades longer. By 1951, Greater Vancouver had 45 per cent of the provincial population. No

other province in Canada has such a large share of its population in one urban area. Although this fact is often stated proudly, it is also a statement of how little we are using the rest of the province, and it may be an unbalanced concentration for the total good of the province. When the population of Greater Vancouver is combined with the figures for Greater Victoria, it is shown that 55 per cent of the people of British Columbia live in these two urban areas.

The actual and percentage growth of southwestern British Columbia has been at the expense of percentage declines in southeastern and south-central British Columbia. In 1901, following railway construction and the beginning of the mining industry, the Kootenay region of southeastern British Columbia had 17 per cent of the provincial population and was the second most populous part of the province. Although the Kootenays experienced a notable growth in population from 1901-11, when many of the mining camps were opened up, the growth was not as remarkable as that in the southwest coast. Since that time population distribution was fluctuated with the opening and closing of mining areas, and the over-all increase has been very small. The chief growth of the Kootenay area can be attributed mainly to the expansion of the urban centres such as Trail, Nelson, and Kimberley, which are concerned with the processing of local resources. Kimberley has Canada's largest lead-zinc mine, and Trail has an enormous smelter, refinery and fertilizer plant. An area of steady decline has been the coal mining region of Fernie-Crowsnest Pass.

Census Division 3, which is primarily the Okanagan Valley, in southern British Columbia, has maintained a steady growth, in step with the rest of the province. Throughout this half-century the area has consistently had about 7 per cent of the provincial population. The two periods of notable increase, 1901-11 and 1941-51, were the same periods of rapid growth in southwestern British Columbia. The total numbers involved are not large, however. The largest increase has been about 25,000 people in the past 10 years. This last decade of growth, however, has almost doubled the population of each of the Okanagan cities.

The south-central Interior, like the Kootenays, has been the other area of relative decline in population in British Columbia. Population came into the region at the turn of the century following railway construction, and the area had 6 per cent of the provincial population. It now has only about 3 per cent. This area is one of the main ranching regions of British Columbia where population densities are low, and cannot expand greatly in that particular occupation. The main centres have been established in the valleys, along the few transport lines, and growth has been chiefly in these urban areas, or has followed the expansion of irrigation agriculture.

Central British Columbia is the only region outside of the southwest which has increased its percentage of the British Columbia population. In 1911 there were only 8,000 people in the whole central interior of British Columbia. The northern branch of the Canadian National Railway was built east-west through Prince George, and later the Pacific Great Eastern Railway came in from the south to Quesnel, giving the region relative accessibility. Population moved in along these lines. The interior is favoured by having one of the larger areas of level to rolling land in British Columbia. The improved road and rail connections of the past decade have aided the growth of the area, which has a good variety of natural resources for balanced economic development.

The central and north coast of British Columbia has always had a small population. Although the climate is similar to the southwestern area, the rest of the coast does not have the natural and economic advantages of the Lower Fraser River Valley. Whereas growth of the southwest coast can be attributed chiefly to the gap and lowlands of the Fraser River, there are no comparable openings to the northward. The fishing and logging population has remained scattered along the coast in small settlements. Population growth is mainly the result of the establishment of special industry towns, such as the pulp and paper centres of Powell River and Ocean Falls, and the growth of the main city and northern gateway, Prince Rupert. There were only about 24,000 people along the whole coast in 1921, and numbers had increased to only 34,000 in 1951.

Much of the northern half of British Columbia is almost uninhabited. Population has never been large, and has been concentrated in small areas of this vast mountainous region. The northwestern area has declined in percentage following the closing down of several mining

camps. The northeastern section, which is mainly the Peace River area, shows an increase, which has followed the opening up of the Peace River block for agricultural settlement.

POPULATION DENSITIES

As stated in the preceding section, British Columbia's population is concentrated in the southwestern region. These people are located in the two main urban areas, and are fairly evenly scattered over the adjoining agricultural lowlands. There are few areas in British Columbia where there is a favourable combination of level topography and good climate. One of the best regions of favourable environment, and one which was also blessed with excellent transport through the strategic gap of the Fraser River, is the Lower Fraser Valley. These natural geographic advantages were apparent from the days of early settlement, and should continue to be the basis of future growth.

The City of Vancouver is occupying most of its political limits except in the southeast. The average density of the city is slightly more than 8,000 persons per square mile. This density cannot be greatly increased by single-family dwellings within the city. The rate of population increase should, therefore, decline in Vancouver, unless there is a greater development of apartment blocks. Vancouver has very little unused industrial land left to attract new industries, compared with the other municipalities. A future increase should, therefore, take place chiefly in the surrounding towns and municipalities which are not yet fully covered with houses. It was already apparent in the 1951 census that the cities and municipalities surrounding Vancouver were growing at a faster rate than was Vancouver. Average densities in Burnaby and North Vancouver are 1,600 and 3,200 persons per square mile, respectively. New Westminster, which has very few empty spaces left had a density of 4,000 persons per square mile.

It has been estimated that there are about 100,000 acres (out of a total of 200,000 acres) still available for residential settlement in Greater Vancouver. Of this potential residential area, Vancouver has 27%. The chief areas of unoccupied land are in the municipalities east of Vancouver and southward on the Fraser River delta. In the case of the Fraser delta, however, much of this land is now excellent farm land, helping to feed the city, and it is doubtful if it should be used for houses.

The Lower Fraser Valley has a number of small towns evenly spaced along the main transportation routes, and has a rural population about equally spaced along the many side-roads. The average densities for the whole valley (excluding Greater Vancouver) are 100 to 125 persons per square mile, which are equal to rural densities of the agricultural regions of southern Ontario and Quebec. Although there are not major differences throughout the valley, the greatest densities are at the opposite ends, in the east, in the good soils and lower lands around Chilliwack, (140 per square mile), and in the west, in Surrey (250 per square mile) and Delta (125 per square mile) municipalities. The municipalities along the north shore of the Fraser River have somewhat lower densities of 50 to 100 per square mile.

The concentrations of people in southeastern Vancouver Island are equally as great as in the Lower Mainland, but they cover a smaller area. Victoria, like Vancouver, is almost fully occupied and has been spilling over into the surrounding municipalities. Suburban settlement has been spreading north into Saanich peninsula and increasing densities there. Since this region has the mildest winter climate in Canada, it has been a favourite place for retirement. Many of these retired people are part-time farmers on "small-holdings", which has further increased the density of rural population. The average of 200 persons per square mile on Saanich peninsula, north of Victoria, is therefore about twice that of the Lower Fraser Valley, and is comparable to some of the rural densities of densely-settled northwestern Europe.

The Okanagan Valley is the only other part of the province where settlement is continuous enough for density figures to be significant. Within the valley, (excluding the lake area, but including the urban populations) average densities of 110 persons per square mile are comparable with those of southwestern British Columbia. The settled areas of the Okanagan, however, are but narrow strips on the lake terraces and are a very minute part of the province's area.

In the rest of British Columbia population is found in parts of narrow valleys, and concentrated in a few small centres. Densities per square mile may be relatively high for these small areas, but most of the surrounding mountains or uplands are empty. For these reasons the densities reported by the Dominion Bureau of Statistics for each of the provincial census subdivisions (which are quite large) are not realistic. They are of use, however, in showing the general density pattern of most people living in southern British Columbia, fewer persons in the interior, and virtually no one in the northern half. These census subdivisions report densities of two to ten persons per square mile in south-central and southeastern British Columbia. Most of central British Columbia, north of the Thompson River, has an average density of one person per two square miles. Densities in northern British Columbia are not significant since most areas are uninhabited.

POPULATION DISTRIBUTION

The pattern of population distribution in British Columbia is linear and concentrated. People are found along several of the valleys, wherever there are transportation lines, and are concentrated in the southwest corner of the province. This distribution is related directly to the topography of the province and to the transportation network. This concentrated pattern is illustrated by the fact that 70 per cent of the people of British Columbia live in urban areas - the highest percentage of any province. Since these urban areas cover a minute part of the provincial area, it is therefore obvious that much of the province is sparsely populated or is empty.

In the southern Rocky Mountain Trench, Census Division 1, there were 28,000 people in 1951. Thus, in an area equal to southwestern Ontario, west of the Niagara escarpment, there are only as many people as are in the city of Guelph or Lachine. About one-quarter of the total population of the region is located in the largest urban centre of Kimberley, and the three main cities of Kimberley, Cranbrook and Fernie together have almost 50 percent of the population of the region.

The West Kootenays, Census Division 2, had 60,000 persons in 1951. The population is also concentrated in a few areas. One-quarter of the total lives in the urban centre of Trail-Rossland, and the three main urban areas of Trail-Rossland, Castelgar-Kinnaird, and Nelson, together have 50 per cent of the West Kootenay population. Since the valleys of the West Kootenay area are much narrower than the broad, rolling valley of the Rocky Mountain Trench, the rural population is located in narrow bands along the main transport routes.

Census Division 3 centres on the Okanagan Valley. Its population of 78,000 in 1951, is but equal to the number of people living on the North Shore of the harbour north of Vancouver. The three main cities of Penticton, Kelowna and Vernon have about 40 per cent of the population of the region. Agriculture is by far the major occupation of the rural dwellers. Most of the population is found on the sloping terraces above Okanagan Lake and its adjoining lakes, where there are better irrigation facilities.

Vancouver and the Lower Fraser Valley are the main parts of Census Division 4. In 1951 there were about 115,000 persons (10 per cent of British Columbia) in the small towns, villages and rural homes of the Fraser Valley. The City of Vancouver had 345,000 people, which was 30 per cent of total provincial population. Another 130,000 persons live in Burnaby, New Westminster, Richmond and adjoining urban areas of Greater Vancouver. No other province has such a major concentration of population in a small section. Greater Montreal, for example, which has almost one-tenth of the Canadian population, is less than one-third of the total population of Quebec. Greater Toronto has less than one-quarter of the population of Ontario. Greater Winnipeg shows a greater dominance in the provincial population, having about one-third of the people of Manitoba. In comparison with these examples, Greater Vancouver has half of the provincial population. Our provincial population therefore has a distribution which is unlike any other part of Canada, and brings about distinctive problems of administration, parliamentary representation, and general resource development.

Vancouver Island had about 215,000 persons in 1951. Half of this total lives in the Victoria-Saanich urban area. Most of the remainder live along the east coast rolling lowland

strip as far north as Courtenay, with a side cluster found in the central part of the Island at the head of Alberni Canal. Agriculture and logging are the major occupations of the people outside of the cities. The manufacture of forest products supports most of the cities. Most of the mountainous interior of the Island is unoccupied and the northern and western coasts have only a few small isolated settlements, chiefly concerned with fishing or logging.

The south-central interior of British Columbia, centering around Kamloops, is Census Division 6, and is one of the sparsely populated areas of British Columbia. In 1951 there were about 42,000 persons in the large area of about 31,000 square miles. In other words, the region is about the size of the Lowlands of Quebec and has a population about equal to Hull. Population is scanty on the uplands, but since there are no major topographic barriers, there are not as many completely empty areas as in the mountains of the southeast. Similar to the urban concentration in other parts of British Columbia, one-quarter of the population is found in the main City of Kamloops.

Census Division 7 is the central and south coast for 250 miles north of Vancouver. There were only 19,000 people in the area in 1951, and they were all on the narrow coastal strips, separated from one another by long fiords which makes land transport impossible. The one major settlement area around Powell River has about 8,000 people, or about 40 per cent of the population of the division. Ocean Falls, with almost 3,000 people is the only other big cluster of people. These two pulp and paper centres together have almost 60 per cent of the people living on the central west coast. The remainder of population is fairly evenly dispersed along the coast in many small fishing or logging settlements. Many sections of the coast remain uninhabited.

The central interior of British Columbia is included in the large area of Census Division 8. Its total of 41,000 persons is double the number that were in the area in 1931. Since this area is part of the rolling Interior Plateau, the topographic control of population distribution which is so apparent in the rest of British Columbia, is lacking here. Population is distributed throughout the large area, so that there are few areas with no people, but on the other hand there are no outstanding concentrations. Prince George and vicinity, with about 20 oer cent of the division population is the main cluster of settlment. Another 20 per cent live southward along the transport lines between Williams Lake and Prince George, and slightly less than 20 per cent are spread westward along the Canadian National Railway line between Vanderhoof and Hazelton.

There are only 21,000 persons in northwestern British Columbia, which is Census Division 9. Most of these people are concentrated in the Prince Rupert area. The city alone has 43 per cent of the people in the Division, and the area between the Skeena River mouth and Portland Canal, along with the Queen Charlotte Islands has 80 per cent of the population. It therefore follows that much of the area inland of the Alaska Panhandle has very few people. In fact, very large census subdivisions in this northwest area have absolutely no inhabitants. Being cut off from the sea by the Coast Mountains, except for the gap of the Stikine River, and having no inland road or rail transport, much of the area is inaccessible. Its potential resources are little known, and development will probably await a greater density of population in central British Columbia.

Census Division 10, in northeastern British Columbia, has the least number of people of all the divisions. Although Canadians have heard of the Peace River area, the British Columbia section of this region is small. There were only 15,000 persons in all of northeastern British Columbia in 1951 and about 90 per cent of them are in the former Peace River Block. Large areas of the northern Rocky Mountain Trench, the Rockies, and the vast, forested Liard plains contain only a few hundred people. Most of the people live south of the Peace River, in the broad, fertile valleys around the main centre of Dawson Creek.

CONCLUSION

The distribution of population in British Columbia is closely related to its physical geography, and to the location of developed natural resources. The only notable areas of level land, which also have favourable climate, are in the southwest region. Although individual

resources are widely scattered in varying amounts throughout the province, the best combination of resources in abundance is in the southwest corner. This region has three-quarters of the provincial population, and shows no signs of any declining growth rates. Although population has been increasing in the interior of British Columbia, the greatest numbers are still being added to the coast population.

Much of the pattern of distribution is related to the transportation network, which in turn, follows a few definite valley routes. The southern and central interior of British Columbia were opened up following the building of road and rail transport lines. As these transport routes are extended, and a branch line road network develops, it should be expected that population densities will expand along these lines from the nucleus concentration on the southwest coast.

ROLE OF GEOGRAPHERS IN SASKATCHEWAN

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Saskatchewan Department of Natural Resources

Introduction

As some of you may know, for the past four years a number of geographers have been employed in Saskatchewan. Accordingly, I propose to discuss, generally, what geographers have been doing in Saskatchewan and briefly suggest how geographers and geographical work have fitted into the administrative framework. What follows is mainly made up of illustrations, of our work in budget planning, the planning of projects such as roads, recreational area planning, regional studies, land use planning, industrial location, community planning, and so on. We hope that these papers will support our thesis that there is an important role for geographers to play in practical work in under-developed regions.

When I attended university, the question of the practical application of geography was a very live question among geography students. It was at times hotly debated. One group maintained that geography is a highly practical subject and our training in it could prepare us for a career as a professional geographer in business or government service. Often this group attacked another group which might be called "The Academic Geographers". These academic geographers, they claimed, were making geography an impractical subject and making it difficult for geographers to obtain professional employment in geographical fields. The academic geographers in defense, replied that emphasis on training for jobs could degrade the geography faculty to the level of a technical school. The important thing, they maintained, was the study of the subject itself.

I think those of us who have been graduated for a time now realize that there need have been no quarrel between these groups. There are two branches to every discipline. The first is the more formal basic study and research which may lead to new avenues of thought, the general advance of knowledge, and even to trends in the philosophy of the subject. The second is the practical application of this knowledge and philosophy in the workaday world.

I must admit that I belonged to the practical school and perhaps still do. Nevertheless, those of us who have worked for a period in the practical field, realize acutely how much we must look to the academic men for leadership in the field of new ideas. Accordingly, we feel particularly privileged to be here today in the presence of geographers of all kinds.

At university some of us maintained that geographers could make a particularly important contribution in resource conservation and development planning in under-developed areas. In Saskatchewan, as I stated earlier, we have had some opportunity to test this thesis.

POLICY

As you know, since the war Saskatchewan has had a reform or progressive administration. This administration has placed stress on both economic and physical planning as an important role of government. At the Cabinet level, the first level of government planning, it has established the only Economic Advisory and Planning Board in Canada and perhaps in North America. This Board of experts, mainly economists, has been active in research and planning in Saskatchewan, but although geographers have maintained liaison, few have worked directly with the Board. The second main level of planning in Provincial governments is at the departmental level. Geographers have taken an active part in planning at this level, particularly in the Department of Natural Resources. A Planning Office with geographers was established in that Department and later geographers were appointed as administrators. This Department gave us a lot of challenging work. The departmental administration was highly progressive and there was much to do. The administration of Saskatchewan's natural resources had been transferred to the Province in 1930 and there followed a long period of depression and war, during which it was impossible to launch new programs or increase efficiency to any extent.

The new administration with an increased interest in the province's forestry, fishery and wildlife resources and with a determination to develop the north and improve the lot of its native people, found itself confronted with many weighty conservation and development problems. The department administration felt that at this relatively pioneer stage of development of resources that professionally trained men generally familiar with resources and development, might be valuable in recommending the broad outlines of resource policies. Accordingly, geographers were hired. It was intended that they would be closely allied with the administration and would be of direct assistance to it in co-ordinating planning programs.

Time does not permit me to review all the major fields of work which geographers have undertaken in Saskatchewan. A number of my colleagues here today will present papers which discuss four major types of work which have been done. Much of this work falls under the general category of planning.

From the start, geographers in the Department of Natural Resources were closely tied to the top level administration, either in administrative or staff positions. I believe this is sound. Planning is one of the chief functions of the administration or the administrator. And planning and execution are but two sides of the same coin. The more closely they are integrated, the better the resultant program. It appears that much program planning in government service in Canada has not been closely tied to administration. As a result, beautiful plans, particularly in resource development and conservation fields, have been drawn up but often little was carried out. Sometimes the plans were shelved because they were not down to earth. They were framed by men who were completely divorced from the sobering effect of administering. Or they were shrugged off by administrators who regarded the planners as ivory tower researchers and who refused to disturb themselves with new ideas. Most plans call for action and new action of any kind means a great deal more work for the administrator. If we have had a measure of success in planning in Saskatchewan, it has been mainly due to the close alliance of the planners and administrators. Geographers in the administration quickly were confronted with real planning problems, some of which I will describe shortly. We never were secluded self-inspired researchers.

BUDGET PLANNING

One of the important planning functions of the Department is budget planning. Most of the policies and programs and projects of the Department are expressed in the budget, the yearly operational plan. Geographers were from the start involved in budget planning. The budget presents some real and complex planning problems. As an example, the budget planning might ask, should we build more fish hatcheries or some northern development roads? Answers can be obtained on this from such people as the fisheries manager, the construction engineer and the forester. It is probable they will not always agree. It is a big question that involves, for example, a general ability to understand the latest thoughts in scientific fisheries management and an analysis of many regional development factors. We recommended that at the particular stage in forest management and northern development we had reached, it would be wiser to spend more money on development roads. We considered it most important to improve fire control and increase forest utilization.

Before money can be budgeted for roads, however, we must know what roads to build, to what standard, and what priority each project will be given. You will realize that decisions on these questions are complex and involve the consideration of many factors. We carried on several studies of regional development factors and resource potentials along the pioneer fringe as a guide to our road planning. Major road locations were planned and priorities on construction were recommended and are still being recommended. The study of the Buffalo region, on which Mr. Brown will present a paper today, recommended road construction as a need in regional development and a major road construction project is now underway.

RECREATIONAL PLANNING

In my first remarks I mentioned recreational area planning as one field of our work. When geographers first worked for the Department of Natural Resources, a policy on promotion

of the tourist industry in the province was under discussion. The Government wondered whether the provincial potential of the industry warranted promotion and larger expenditures on encouraging the development of outdoor summer recreational sites. As a consequence a geographer was hired to study the tourist industry. This project led to a study of the development of the Provincial Parks and a major physical planning project in recreational area planning.

REGIONAL STUDIES

We did our most extensive pure geographical work in regional studies. The main interest of the department was focused on the almost entirely undeveloped northern half of the province - part of Canada's last frontier. It was realized that development factors and problems and resource potentials differed from one area to another across the north. Vague regions were already defined in the minds of the administrators. Geographers were asked to study areas or regions where major development problems existed or where it was believed there are large untapped resource potential. Most of these areas had heretofore never been extensively studied by trained men such as foresters, biologists, geologists, and so on. It seemed logical that geographers should make the first general studies. Their recommendations following these regional studies, have resulted in more intensive studies in specialized fields. Also as a result of these studies some policies and programs have been initiated or modified and some new development projects have been started.

Naturally we have used the regional concept extensively as a basis for studies and it appears that practically there is nothing difficult to understand in the concept of regions when it is actually applied. Almost everyone living in an area is conscious of regional differences. It seems that schools of geography often tend to make of the region a much more difficult and mystical concept that it need be.

THE BUFFALO REGION

Our work in the Buffalo region illustrates operationally one type of regional study carried out. We recognized this as a problem region of high and increasing native population and low resource productivity. We had, however, little exact knowledge of the gravity of the problem or the trends in it. The study of the region contributed greatly to our understanding of the development problems of it, the reasons for them and indicated possible partial solutions. There was no easy solution because, to a degree, the problems in this region are the problems of over-populated and under-developed regions everywhere.

This regional report emphasized the importance of the cultural attitudes of the native people in regional development. Partly as a result of this, an anthropologist was employed to begin research and studies on native culture in Northern Saskatchewan. To me there is no more important problem in the North today than the unhappy outlook for many of our "aboriginal" peoples - the Indians and Metis. It is a situation that reflects badly on many of us who have loudly criticized the policies of other administrations toward native peoples in Africa and Asia and elsewhere. It seems there has been too much well-intentioned sentimentality on the part of administrators who have little knowledge of the North, behind our native policies. Certainly there has not been clear, progressive and farsighted policies and there is still indecision today. This is a challenging question that calls for study by the best and most devoted of our students interested in cultural groups and their welfare. There is room here for work by cultural geographers for we know that we have only begun to obtain the background information and trends of thought which we hope will lead us to the formation of sound policies in regard to native peoples in our North.

THE SASKATCHEWAN DELTA

I would like to mention also the regional study of the vast Saskatchewan Delta area lying between the towns of Carrot River, Saskatchewan, and The Pas, Manitoba. It was believed

that valuable agricultural lands awaited drainage in this area. Our purpose was not only to survey general agricultural possibilities, but to study the problem of possible conflicting land uses, should agricultural development take place. Large lowland areas are productive of muskrat and beaver. If all this land were drained the comparatively large native trapping population could be left without their traditional economic support. Another big question was whether some effective policies or programs could be framed to encourage the natives, mainly Metis, to take part in agriculture. Various types of schemes have been tried across western Canada to achieve this, but few have met with much success. The problems of possible conflicting land uses in this area and of promoting native agriculture are not yet solved but we believe our thinking on them has clarified somewhat and our policies are now sounder.

Following this study, reconnaissance soil surveys have been carried out by the provincial Department of Agriculture in which several hundred thousand acres in the region were declared arable and the P.F.R.A. has begun a major engineering survey, the Saskatchewan Reclamation Project.

This suggests a point I would like to emphasize. At no time have we employed geographers simply to survey soils. There are soil specialists available, far more qualified to survey and rate soils. Neither have geographers cruised timber stands or undertaken detailed geological studies. There are foresters and geologists better equipped to do these tasks. A geographer cannot ordinarily hope to do work in these fields comparable with the specialist. In most cases for our work it is not necessary that he have more than a working practical knowledge of these specialized fields.

STANDING COMMITTEE ON LAND USE

I stated earlier that our group undertook work in land use planning. Geographers engaged in administrative or budget planning in the Department met the budget problem of high costs in fire control and forest losses through fire in new agricultural settlement areas in the forest where settlement planning was rather haphazard. Sometimes too, there were losses in expenditures on forest management plans on forest areas which soon after were developed for agricultural purposes. This situation is common throughout the pioneer fringe in the West and is not new in Canada. In the history of pioneer settlement in the forest in Canada, vast forest areas have often been burned over and the productivity of much land destroyed for many years in the process of establishing agriculture on relatively small areas.

It was clear in Saskatchewan that more formal administrative processes and planning were required in pioneer settlement to protect the forest. Geographers took an active part in planning the establishment of an inter-departmental standing committee on land use comprising the Departments of Agriculture and Natural Resources. This formal organization requires complete land use studies and development plans by both foresters and agriculturists before decisions are made on opening up new areas for settlement. These procedures have not assured perfection in land use planning but they have assured that every question of land development will receive careful review and careful planning. This planning will reduce considerably the hardships of pioneer settlement and the forest losses.

The setting up of this organization was a major analysis of land development policies and legislation. Through the organization established, geographers in the Department are still taking an active part in forming land use decisions.

INDUSTRIAL LOCATION

Industrial location was also mentioned in the introduction. It is a well known fact that the bulk of Canadian manufacturing industry is concentrated in Eastern Canada. Accordingly, one hears a lot about industrialization in Western Canada and particularly Saskatchewan which is least industrialized of the Western provinces. The West is convinced that this imbalance in industry is not only a bad thing for the West but for Canada as a whole. Westerners believe the West needs more people. I think there are good arguments to support this view. It appears that only new industries can support these larger populations.

None of the larger provinces is so dependent as is Saskatchewan on a single industry which is highly dependent in turn on foreign markets. For these reasons one hears a great deal of talk about the diversification of industry in Saskatchewan and in recent years, industrialization has been a main program of the government. An Industrial Development office has been established and both geographers and economists have been employed in industrial research. For industry in general or for promotion of a specific industry, volumes of information have been assembled on local resources, national and international markets and availability of power, capital, labour and so on. The work not only involves the collection and compiling of this data in readily available form, but also the meaningful interpretation of it. Geographers have been valuable in this and naturally they have taken part in the field of industrial promotion also. One graduate geographer, for example, Mr. Tom Ward, now holds a senior position in our Industrial Development Office.

COMMUNITY PLANNING

Geographers in some sections of Canada have played an important role in community planning. In Saskatchewan they have devoted less time to this. Most of our community planning work has been in the Northern District, administered by the Department of Natural Resources. Here there is minor planning in small towns and villages, some mainly of native population, dependent on fur, fish and tourism, like La Ronge, and Ile a la Crosse. However, there has been more important planning work in the new mining towns which are developing such as Creighton and Uranium City. In these new towns, there are not only the physical problems of town planning in difficult isolated Shield areas. There are also administrative and financial planning problems which are highly important in developing pioneer townsites in areas which were never habited before and to which transportation is costly. There is much talk in Canada of populating the North but obviously to accomplish this, people must be attracted from alternative forms of living elsewhere and induced to remain in what we must admit is often considered an inhospitable country. The planner, therefore, is confronted with the physical, administrative and financial problems of establishing modern living conditions as rapidly as possible in a rugged isolated area. In this field we believe we have contributed some new ideas and methods as is exemplified by our work in relation to the now famous Uranium City, a new mining town which has developed in Saskatchewan in the past two years.

I could go on with these illustrations but enough has been said to indicate the diversity of work in Saskatchewan. Indeed, there are many fields which are not yet even touched. One example is intensive studies leading to recommendations for water use in smaller water sheds. This is an important work into which we have recently been drawn through our interest in wildlife and fisheries management.

CONCLUSION

Perhaps our work may be criticized for being too diversified. Had we concentrated on one or two major fields, undoubtedly our work would have been of a higher professional quality and of more value for application elsewhere. As it was, we were closely tied with the administration and constantly met many interesting problems which required rather sketchy work resulting in immediate guidance for the administration.

Nevertheless, I believe that the type of geographical thinking and perspective we brought to Saskatchewan has been a contribution in planning development programs and policies at this stage in the province's development. I must leave it to those academic people here to clearly define geographic thinking. To us it means an ability to integrate a great number of development factors into a meaningful complex. It means a perspective on the meaning of resource facts (acres of soils types, cubic feet of standing timber, tonnages of ore) in the broader picture of regional development. It embraces an ability to sense and understand economic and historical trends. Geography in this type of application certainly is not a science. But it is much more than the compilation of data or the concentration on one fragment of the regional complex. It is an art that is possessed by many who are not geographers but which geographic training may help to induce.

Those of us from Saskatchewan are convinced that geographers do have a practical role to play in under-developed regions. There are many areas in Canada much more under-developed which may be in need of geographical work. We feel there is no need for geographers interested in pioneer regional development to ask themselves what they should be doing. The frontier is waiting for them.

THE APPLICATION OF REGIONAL SURVEYS IN PROVINCIAL ADMINISTRATION, WITH AN EXAMPLE FROM THE BUFFALO REGION OF NORTHWESTERN SASKATCHEWAN

C. S. Brown

Saskatchewan Department of Natural Resources

A paper has been presented on the various roles in planning of resource utilization played by geographers in recent years in Saskatchewan.[1] It explained the opportunity given geographers to take leading participation in all phases of planning, from research to administration. Mention was made, too, of the regional study which is the subject of this paper.

Saskatchewan can be divided from south to north into three major zones on an economic basis, a southern agricultural zone, an agricultural frontier or transition zone, and a northern forested zone. The latter is relatively undeveloped and here the government vests all local government as well as resources administration responsibilities in the Department of Natural Resources.

Very early in the post-war period the government focused considerable attention on the north. The apparent potential in undeveloped resources, and the social problems and unsatisfactory living conditions among the indigenous population, prompted study and the launching of various remedial programs. In the early enthusiasm some of the programs undertaken were not sufficiently well thought out and planned, and as a result, some failed. Hence, the government grew more cautious and inevitably saw the need for more studies and longer term planning.

The northern district under the administration of the Department of Natural Resources has an area of about 110,000 square miles or about two-fifths of the total area of the province. Eight thousand of its ten thousand inhabitants live in settlements on the richer sedimentary areas along the southern fringe of the Precambrian outcrop or on adjacent accessible parts of the Precambrian. Some two thousand six hundred live in an area readily defined as the Buffalo Region in the south-western corner of the district about the headwaters of the Churchill River.

It had long been apparent to northern administrators that local problems varied greatly in nature and in gravity from one part of the district to another. The concept of regionalism was, therefore, not entirely new to them. The Buffalo Region had for some time presented some acute problems. Although no specialized studies had been made there, it was apparent that resources utilization and development were not keeping pace with population increases. The social and economic problems arising out of this situation appeared to be growing.

It came about, then, that the Planning Office of the department, composed in 1951 of a senior and a junior geographer were faced with the task of studying the problem and devising means to alleviate it. Very little accurate information was available. The area was remote and isolated, and relatively inaccessible except by air. Most of the policies and programs in effect in the north appeared to have done little more than to intensify the problem. In view of its general complexity it was decided that only a fairly comprehensive regional analysis would provide information which might form the basis for a solution. It was not proposed that the resources be studied in detail, but rather that it be determined whether or not a potential existed to be developed which would warrant more specialized study. Another major objective was a better appreciation of the factors - social, cultural, and economic, which gave rise to the obvious antagonism to well meant government sponsored programs in that region.

The writer started work on the project in mid-summer of 1951. There follows a summary of the report prepared after the investigation.

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[1] Davidson, A. T.: Role of Geographers in Saskatchewan.

The Buffalo Region, about 5,000 square miles in area, straddles the 56th degree of latitude well to the north of all populated parts of Canada, except for the Peace River area. (Figure 1) Its centre is nearly 120 air miles north of the nearest railhead - Meadow Lake,

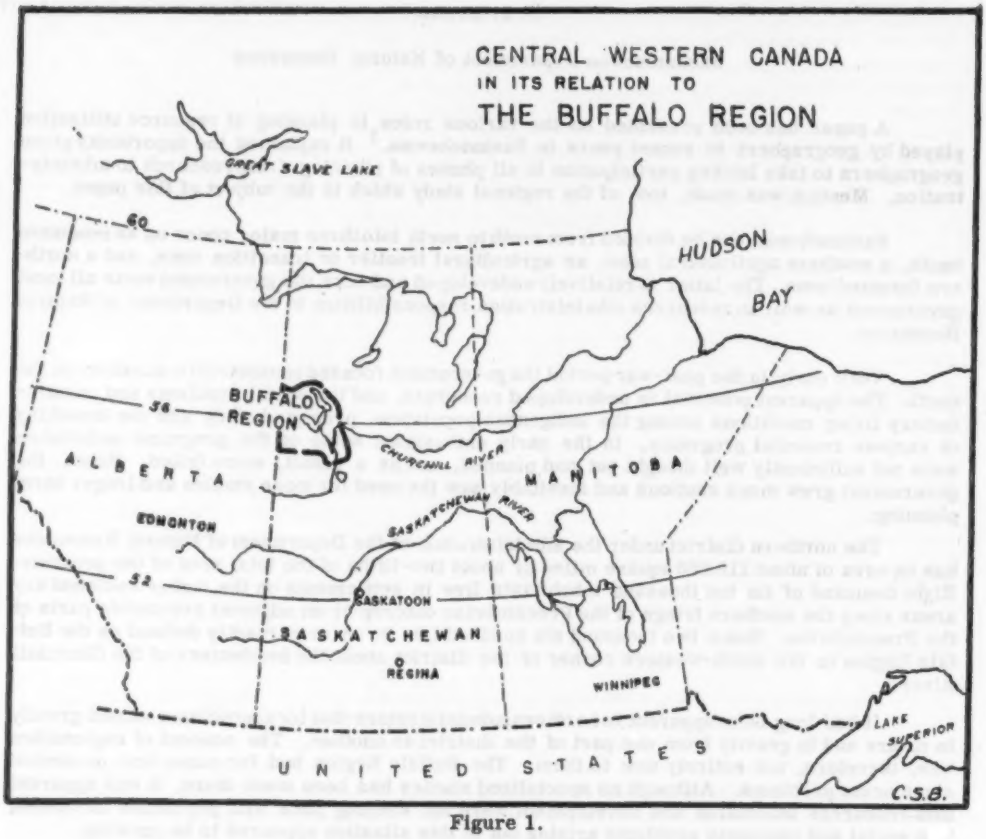

Figure 1.

and 200 miles from the nearest city - Prince Albert. An inferior bush trucking road, impassable to passenger car traffic in most seasons, which connects with a lake ferry service in summer, provides the only overland access to the region. Telegraph, two-way radio, and weekly aircraft service provide communication between the major communities and with the outside. (Figure 2)

The region lies in a poorly defined trough between the northern end of the Missouri Coteau in Saskatchewan and the Precambrian shield. It is drift covered, with the underlying Palaeozoic sediments exposed in places on the Coteau escarpment. No Precambrian outcrop appears in the trough. The drift throughout the region is largely a sandy till of varying depths with a compact boulder clay till in evidence in places. There has been considerable wind and water working of the light textured surface deposits.

The headwaters of the Churchill River occupy the trough and drain the eastern slopes of the Coteau into several large lakes on the trough floor which form a regional base level of 1,380 feet above sea-level. The drainage pattern is poorly defined generally with large areas of intermittent sand ridge and muskeg throughout the floor of the trough. Lakes are relatively shallow and the rivers slow moving and weed filled, with occasional boulder strewn rapids.

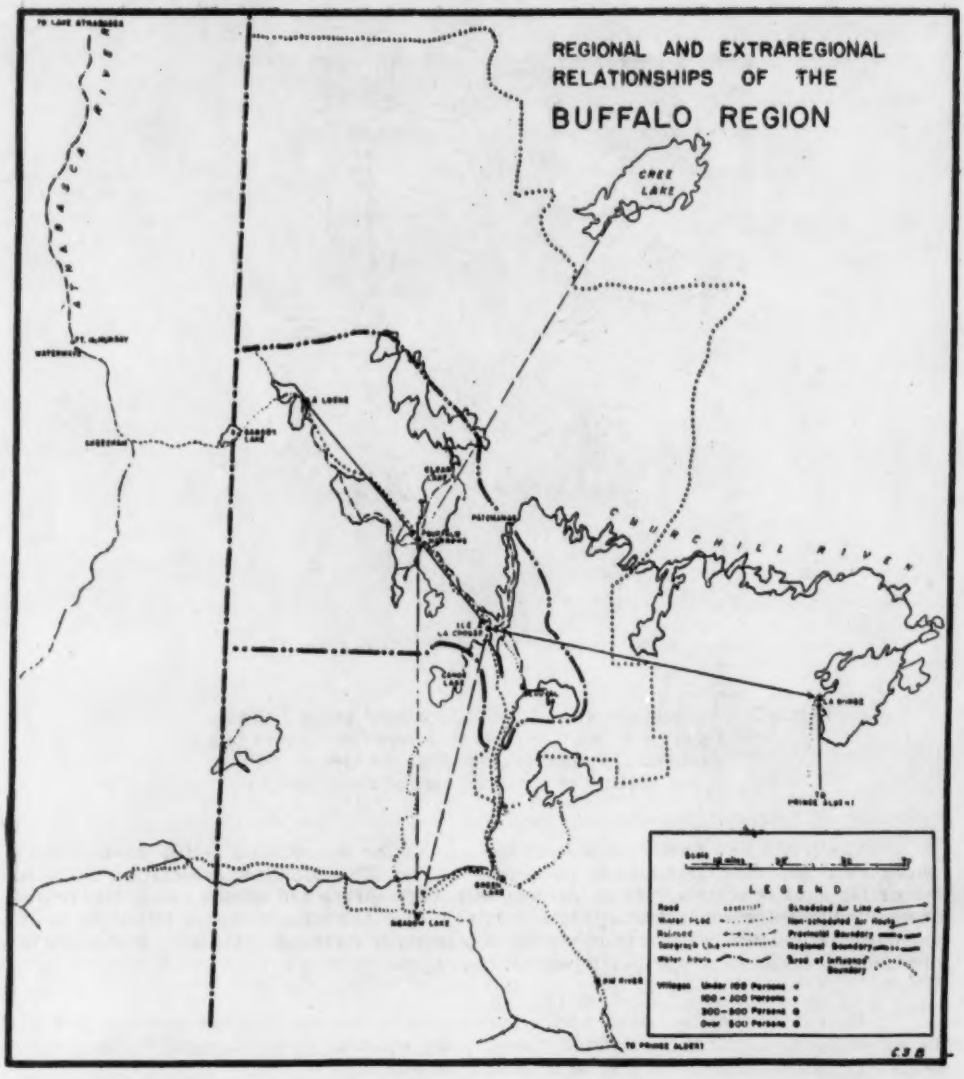
REGIONAL AND EXTRAREGIONAL
RELATIONSHIPS OF THE
BUFFALO REGION
CREE LAKE
CHURCHILL RIVER
LEGEND
Road
Railroad
Telegraph Line
Water Route
Scheduled Air Line
Non-scheduled Air Route
Provincial Boundary
Regional Boundary
Area of Influence Boundary
Villages Under 100 Persons
100 - 200 Persons
300 - 500 Persons
Over 500 Persons
TO PRINCE ALBERT
C38

Figure 2.

The climate of the region compares well with that of the central prairies. High latitude with long hours of insolation and large water surfaces allow surprisingly long frost-free seasons in favoured locations. In general, climatic factors influencing vegetative growth directly, and affecting physiological comfort, are equally as advantageous as in most parts of southern Saskatchewan.

Very little agricultural soil by Saskatchewan standards can be found. Most is very coarse except for small isolated occurrences of clays and loams, and all is highly podsolized except for immature alluvial soil s on river levees in places. (Figure 3)

Figure 3. A typical profile of podsolized sand under jackpine forest and dwarf blueberry forest floor cover in a particularly moist season. Note the clearly defined upper horizon of strongly leached clear sand.

The region lies in the northwest extremity of the mixed wood belt in Saskatchewan, where it merges with the northern coniferous forest. The dominant association on the few favourable sites is white spruce and aspen, with black spruce and tamarac in poorly drained areas, and jackpine where drainage is excessive. Fire has taken a severe toll of the forests and there are relatively few mature stands of potentially marketable timber. Blueberry is a predominant forest floor species throughout the region.

Most of the area is suitable habitat for various fur-bearing and game animals. The most important species from the utilization viewpoint are squirrel, muskrat, mink, beaver, moose and bear. Wild fowl contribute to local larders in season.

Most of the nine hundred odd square miles of lakes of the region are highly productive of fish, whitefish being the most important commercial species.

From the late 1770's the waterways of the Buffalo Region were an established part of the main trade route for the traders from Hudson Bay and Montreal to the Mackenzie River basin. Trading posts were quickly established at various places within the region, and Ile a la Crosse, the site of one of the first, is second only to Cumberland House as the oldest continuous white settlement in Saskatchewan. The Churchill and Mackenzie River systems were linked by the famed thirteen-mile Methy Portage over which furs and supplies were moved by a gang of "roustabouts" - Athabasca, Chipewyans and French-Canadian half-breeds. Their Metis descendants now form a community of some six hundred persons at La Loche.

The settlement pattern did not change significantly throughout the nineteenth century. Trading posts were established and abandoned. The large majority of the natives remained nomadic in habit, coming to the posts only to trade and visit. Roman Catholic Missionaries arrived and established in major communities. The first school was opened in Ile a la Crosse in 1860 by the Mission. Fur continued to be the only basic source of income. No reliable estimates of population are available for this period.

Various significant changes have taken place in this century. The Mackenzie drainage system was tapped by a railroad through Alberta and the people of La Loche lost their means of livelihood and the Buffalo Region its strategic importance in the fur trade transport. Further change was brought about early in the present century by the start of commercial exploitation of the fish resources. The catches taken in winter were first moved to railhead at Big River and Cheecham, Alberta, by oxen and horses. Local natives obtained only casual employment as labourers in these operations, while the majority of the catch was taken by white fishermen from outside.

This early influx of white fishermen and teamsters caused considerable disruption in the native communities. It contributed to various forms of demoralization and exploitation. Some of the whites stayed north to compete with the natives for a share of the fur and game resources.

Numerous other more recent factors were to change the northern way of life. Schools were built and native children were encouraged to attend. Provincial outpost and mission hospitals with medical treatment were provided, and the sick encouraged to use them. Expectant mothers learned the benefits of hospital births. More and more tuberculosis sufferers were sent to provincial sanatoria for treatment and often for cure. Social aid services extended into the region.

With improved transport and communications, factory made articles became more readily available. While in the early days the traders had relied on the natives for many articles of trade such as clothing, footwear, canoes, snowshoes, dog harness, sleighs, fish nets, etc., this type of home industry gradually decreased and the old skills are now lost. Also, with store foods more readily available, the natives' dependency on hunting skill diminished and most are no longer very able hunters.

More recently, family allowance became payable and monthly attendance at post offices was required. A conservation block system came into effect and this tended to localize trapping and hunting activity. In keeping with this system, marketing of beaver and muskrat pelts through a central government marketing agency became compulsory. Although this policy was economically sound and designed to increase trappers' incomes, one direct result was the loss to the trapper of his credit with local traders, without which he was unable to finance trips to distant trapping grounds. A further result of this development has been the gradual loss of interest in keeping dog teams, and today relatively few native families are equipped with good dogs, the only practical means of winter travel.

It is apparent that most of the above factors have contributed to the tendency for the average native family to forego its nomadic habits and reside more or less permanently in communities, with increased dependency on white men's devices. Unfortunately, the change has come too rapidly to allow a corresponding adjustment in native philosophy and social habits. The native has not learned to assume any kind of community responsibility. He has no acquisitive urges. He is content to live as his forefathers, with no more worldly property than could be loaded into a canoe. He has no concern for tomorrow, and any surplus beyond the needs of the hour have no real value. In most cases he is still very reluctant to assume

any responsibility which might further hinder his freedom to wander in response to the urge of the moment.[1]

Figure 4. Natives' homes at Dillon on Peter Pond Lake. The one on the left is typical, the one on the right much better than average. Nearly all are of log construction with mud chinking. Few have roofs of other than tar paper. The house yards are generally poorly defined, though some have small separate garden enclosures.

Several of the factors summarized above have contributed one way or another to a population problem. Family allowances have encouraged larger families. Medical and hospital services have decreased infant mortality rates drastically, and increased life expectancy, and, consequently the span of the productive years on the average woman's life. Adoption of an easier way of living with relief from the rigours of nomadism has decreased the mortality rates from related causes.

In 1951, Mr. R.G. Young initiated and directed a population count throughout the northern district of Saskatchewan. The population of the Buffalo Region was then 2,600, 10 per cent were whites, 72 per cent Metis, and 18 per cent Treaty Indians. Reliable early records of population are not available, but it is apparent that the numbers remained fairly constant through the fur trade era to the present century at only a fraction of the present total. In 1921 the population, other than Treaty Indians, had increased to 1,080, according to an analysis of the federal census figures. Thus the population appeared to have doubled from 1921 to 1951. Analysis of the 1951 census indicated some startling relationships. Twenty-three per cent of the Indian and Metis groups in 1951 were under the age of six years. The rate of natural increase appears to be triple the average rate for Canada. The birth rate per one thousand persons averaged eighty for the years 1948 to 1951 according to provincial vital statistic figures studied, while the comparable rate for Canada was about twenty-eight. Ignoring emigration factors, the population could be expected to double in about thirteen years.

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[1] This situation applies generally to the indigenous population throughout northern Saskatchewan, and is described more fully by R. G. Young: The Situation of the Metis of Northern Saskatchewan in Relation to his Physical and Social Environment.

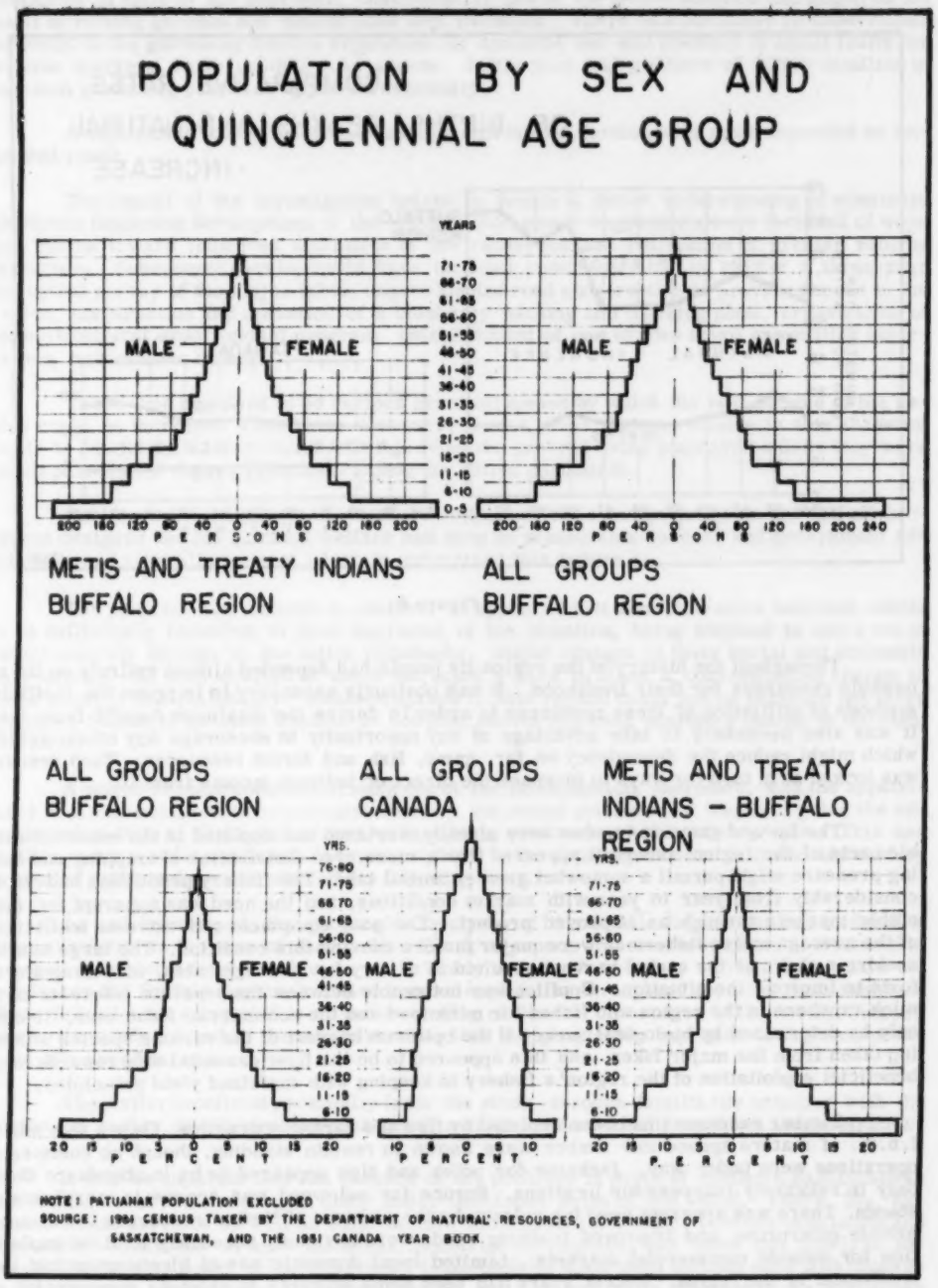

POPULATION BY SEX AND QUINQUENNIAL AGE GROUP
YEARS
71-75
66-70
61-65
56-60
51-55
46-50
41-45
36-40
31-35
26-30
21-25
16-20
11-15
6-10
0-5
MALE
FEMALE
200 180 120 80 40 0 40 80 120 180 200
PERSONS
METIS AND TREATY INDIANS BUFFALO REGION
200 180 120 80 40 0 40 80 120 180 200 240
PERSONS
ALL GROUPS BUFFALO REGION
ALL GROUPS BUFFALO REGION
YRS.
76-80
71-75
66-70
61-65
56-60
51-55
46-50
41-45
36-40
31-35
26-30
21-25
16-20
11-15
6-10
MALE
FEMALE
20 15 10 5 0 5 10 15 20
PERCENT
ALL GROUPS CANADA
MALE
FEMALE
10 5 0 5 10
PERCENT
METIS AND TREATY INDIANS – BUFFALO REGION
YRS.
71-75
66-70
61-65
56-60
51-55
46-50
41-45
36-40
31-35
26-30
21-25
16-20
11-15
6-10
MALE
FEMALE
20 15 10 5 0 5 10 15 20
PERCENT
NOTE: PATUANAK POPULATION EXCLUDED
SOURCE: 1951 CENSUS TAKEN BY THE DEPARTMENT OF NATURAL RESOURCES, GOVERNMENT OF SASKATCHEWAN, AND THE 1951 CANADA YEAR BOOK

Figure 5.

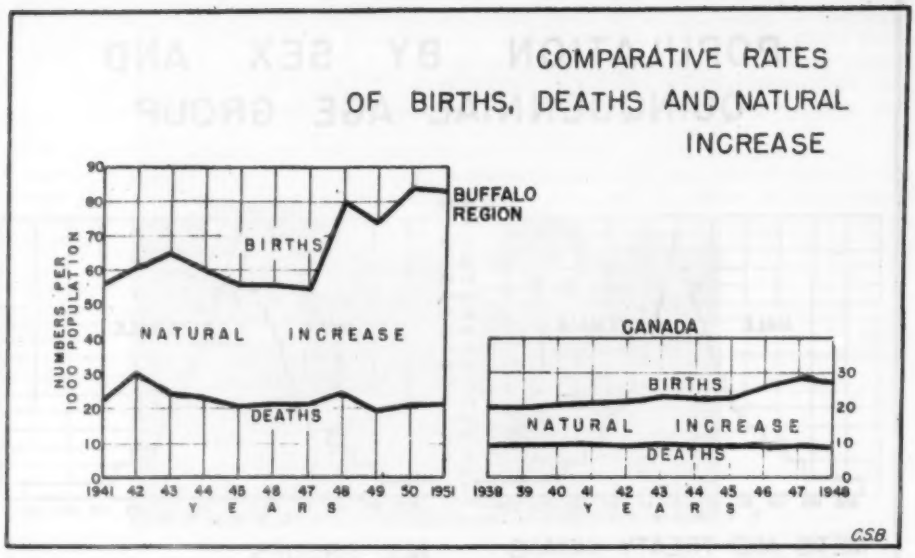


Figure 6.

Throughout the history of the region its people had depended almost entirely on its renewable resources for their livelihood. It was obviously necessary to improve the inefficient methods of utilization of these resources in order to derive the maximum benefit from them. It was also necessary to take advantage of any opportunity to encourage any other activity which might reduce the dependency on fur, game, fish and forest resources. Each resource was looked at in turn for ways to increase the direct or indirect income from it.

The fur and game resources were already overtaxed and depleted in the more accessible parts of the region, though it appeared that a more even distribution of trapping and hunting pressure might permit a somewhat greater annual take. The fishery production had varied considerably from year to year with market conditions, and the need was apparent for more stable markets through an improved product. The poor equipment and extreme inefficiency of the average native fisherman were major factors causing this condition. The large number seeking a share of the annual harvest resulted in a very low average catch, hindering any efforts to improve the situation. Conflict was noticeable between the separate interests of the mink ranchers in the region who fished for mink feed and the commercial fishermen. It could only be determined by biological survey if the optimum harvest of the various species was being taken from the major lakes, and this appeared to be the first essential step towards more beneficial exploitation of the region's fishery in keeping with sustained yield principles.

Timber resources had been depleted by fire and earlier extraction. Only a few million f.b.m. of mature spruce saw timber were known to remain standing, though no commercial operations were under way. Jackpine for poles and ties appeared to be in abundance though only in relatively inaccessible locations. Spruce for pulpwood was scarce in merchantable stands. There was apparent need for release by the province of timber resources to encourage private enterprise, and improved trucking roads were obviously necessary to allow exploitation for outside commercial markets. Limited local domestic use of blueberries had been traditional in the region. Recent years had seen some attempts to promote commercial exploitation of the large annual crop for outside markets. Encouragement of this industry appeared most desirable and here again inadequate road access was a major obstacle, though deep freezing and winter hauling were possibilities.

Success from domestic horticultural efforts had been rather outstanding in numerous instances in spite of the poor soil. Unfortunately few of the native families had acquired the habit of raising gardens and almost none kept livestock. There was obviously an undeveloped potential in the gardening field in vegetables for domestic use and possibly in small fruits for outside markets, again pending road access. Instruction and guidance of native families in common gardening practices appeared necessary.

A significant tourist potential was apparent but its development again depended on improved roads.

The report of the investigation helped to create a better understanding of economic problems hindering development of the region. Numerous suggestions were included of ways and means toward improved utilization of the resources and realization of greater returns therefrom. Subsequent developments have included commencement in 1952 of a three-year biological survey of the major lakes, unprecedented road construction to provide access to the region, construction and operation of a blueberry packing and freezing plant, organization of an horticultural experimental program, establishment of one or two small sawmilling enterprises, and various others.

There thus appeared to be various practical means by which the real income of the region could be increased somewhat. However, it was clear that any efforts in this direction would be relatively ineffective toward improving the general living standards unless they were accompanied by a change in attitude among the native population.

Past government efforts to enlist the support of the average native in any and all programs designed for his common welfare had seen no measurable success and government administrators generally were at a loss to understand this failure.

The problem was difficult to analyse. It appeared that administrators had been unable to be sufficiently objective in their appraisal of the situation, being inclined to use a set of values entirely foreign to the native philosophy. Major changes in their social and economic environment had been effected at much too rapid a pace to allow a corresponding change to come about in that philosophy. Rapid progress in this regard could not be expected but there appeared reason to question whether or not past efforts had even started a change in the right direction.

A major recommendation arising out of the investigation, therefore, was the appointment of a well qualified anthropologist to study the social problems at length to guide the administration toward their goal of improving living standards of the native people. This and similar recommendations from other geographers in the department were followed and a study in applied anthropology was started the following year.

As had been hoped, the geographic analysis of the Buffalo Region was not confined in its applicability to the area of study. Mr. Young's paper, referred to earlier, indicates that the major problems introduced here, particularly those with social or cultural bases, are not peculiar to the Buffalo Region, but have general application throughout northern Saskatchewan. Their definition here assisted in an understanding of them in other parts of the north. Furthermore, the study proved to the administration that the geographic approach to regional problems is a practical one.

The writer benefitted personally from the study, through familiarity acquired with the region, its people, and its problems, invaluable in his present work in northern administration.

It will be apparent that the essence of the problem in parts of northern Saskatchewan is a miniature of that existing in many under-developed parts of the world. There, too, expanded social services as well as other factors have upset the balance between population and renewable resources. In most instances industrial development has come too slowly to increase the earning power of the indigenous inhabitants to allow them to keep pace with changes in the economic environment. It is possible too, that cultural traits inherent in the indigenous group have prevented them from taking advantage of the opportunities offered by industrial development.

Fortunately, in Saskatchewan, this group forms an insignificant fraction of the province's population, and, therefore, the problem is not of major provincial consequence. Where the problem group includes a majority of a nation's population, a grim dilemma indeed, confronts that nation's administrators.

THE SITUATION OF THE METIS OF NORTHERN SASKATCHEWAN IN RELATION TO HIS PHYSICAL AND SOCIAL ENVIRONMENT

V.F. Valentine and R.G. Young

Saskatchewan Department of Natural Resources

Up until the last fifteen years or so, the life of the 7,100 Metis and Treaty Indians, located in the north half of the Province of Saskatchewan, had been based upon a nomadic existence determined by their dependence on fishing and trapping. However, commencing with the early 1940's certain external forces began to act upon these people with the result that their former way of life is now passing through a transitional, and in many respects, confused period of change. Some of the results are beneficial while others are deleterious. The interacting forces effecting these changes can be divided into two broad groups: (a) those activities on the part of venturesome enterprise to explore and develop northern Saskatchewan's mineral and tourist potential, and (b) those endeavours on the part of provincial and federal government alike to further the well-being of the area's indigenous folk.

This paper has a dual purpose. In the first place it will present a brief sketch of the economic situation extent among the Metis people, and secondly it will endeavour to show the relationship of their dilemma with inadequacies in their physical environment and with certain complexities of their social milieu. It might be said here that were the problem simply one of insufficient resources, there would be little difficulty in finding and implementing effective remedial measures. However, there exist certain facets in the social organization of the Metis folk which render rather difficult the successful application of most programs designed to assist these folk.

Perhaps at this point, it would be wise to digress for a moment to elucidate upon the term Metis. These people, who came into being over two centuries ago, were the products of unions - both permanent and otherwise - between Indian mothers and European fathers. In the main they have adherred to the nomadic life of the hunt and have acquired a cultural background akin to that of their aboriginal forefathers.

THE PHYSICAL ENVIRONMENT

By northern Saskatchewan I am thinking more specifically about that portion of the province located to the north of the 55th parallel of latitude. In this broad expanse is included approximately 110,000 square miles of the Canadian Shield plus a narrow strip of the palaeozoic fringe abutting the Shield on its southerly edge. Incidentally it is in this fringe that the large majority of the 3,600 Metis people are located.

Little descriptive material need be given about the Precambrian portion of the province. All geographers should have general appreciation of the type of country thus involved. It was rather aptly described several years ago by a fellow geographer who said it consisted "of a great deal of water with some land showing through". A glance at the map will convince one that this statement, given in a moment of whimsy, has more than a modicum of truth in it.

The whole area has been glaciated and one finds glacial debris aligned in a northeast southwest fashion. Areas with soil are decidedly limited and are found almost entirely in the palaeozoic fringe. The soil is mainly of the grey forest podzolic type.

Northern Saskatchewan, located as it is in the heart of the continent, has a typical continental-type climate with a marked annual range of temperature. To be more specific it falls within the type Dfc of the Koeppen system of classification.

With one or two exceptions the tree cover is rather poor and consists of stands of small spruce, jackpine and aspen. However, there are some very good stands of spruce and jackpine timber located in the Cumberland area as well as in certain locations along the Churchill system.

THE PRESENT SITUATION OF THE METIS

The whole existence of the Metis folk in northern Saskatchewan is centred mainly on hunting and trapping with fishing playing a decidedly secondary role insofar as income is concerned. The main species trapped are muskrat, beaver, fox, squirrel and weasel. Of these, by far the most important are muskrat and beaver. Relative to standards applicable in the more settled parts of Canada, the annual family income (as it is provided by trapping) is not very high and on the average does not likely exceed $700. In many communities it is considerably less.

Until a short time ago, trapping in northern Saskatchewan had witnessed some lean years. Lack of management and due regard to the natural reproductive ability of the beaver, in particular, had all but eliminated this animal. In the year 1943-44 the reported take of this species in the northern part of the province had fallen to 1,000. It was obvious that immediate corrective measures had to be taken. One such step was the institution of the block conservation system in which the top half of the province was divided into conservation areas with a fixed number of trappers assigned thereto. In addition the provincial government made it mandatory to ship all muskrat and beaver pelts to the Department of Natural Resources in order that a closer check might be kept on the taking of these animals. This department in turn uses the Saskatchewan Fur Marketing Service (a Crown corporation) to market these furs.

Meanwhile, in each of the conservation blocks a council was set up from the member trappers to govern the future trapping activities of the block. This council, inter alia, was made responsible for recommending annually the number of muskrat and beaver pelts to be taken from the block. It was made incumbent upon the member trappers to give an accurate count of the number of beaver houses on their respective trap lines, in order that the annual take might be decided. That this system, from the point of view of beaver propogation has been an unqualified success, is borne out by the fact that the number of beaver marketed in 1952-53 exceeded 10,000 compared to 1,000 in 1944.

Fishing is of considerably less importance to these people. Though lake fish constitute a vital part of the diet of the Metis their participation in commercial fishing brings an income return relatively small compared to trapping. There are obvious reasons for this. In the first place these people came into being because of the quest for furs and their economy as well as social organization, is traditionally based on trapping. The nomadic nature of this occupation makes it rather difficult for the native to apply himself to any other form of occupation. Then, too, one must not overlook the fact that it would be in the interest of the fur traders to do all in his power to discourage any excursions by the Metis into such occupations.

Nevertheless, some Metis have ventured into this field - particularly in the Isle a la Crosse-Buffalo Narrows region. Very few, however, list themselves as fishermen pure and simple. Trapping is engrained too deeply into their thinking and for the most part one finds that these people list themselves as trapper-fishermen or fishermen-trappers, depending on the degree to which they have divorced themselves from their dependency on trapping.

At best the fisheries industry of northern Saskatchewan is an insecure one, due to the many impediments with which it must contend. Its market, for example, is located largely in the eastern U.S.A. where it must compete with the fisheries not only on the seaboard, but also on the Great Lakes. It has to contend also with the problem of transporting this produce from such out of the way places as Snake Lake, Wollaston Lake, Churchill Lake, etc., to railhead. One of the major species produced in northern Saskatchewan is the whitefish. Unfortunately, this fish is infested with a tapeworm of the flesh (triaenopherous crassus) which produces a repulsive rice-like cyst in the body wall. Wherever the concentration of these cysts is heavy it is necessary to fillet and candle the fish. This adds to the cost of the product.

One other vocation which is being followed to a very limited extent (but which holds forth a fairly bright future) is lumbering. As earlier mentioned there are some fairly good stands of timber located at various places along the Churchill system, and also in the Cumberland area. The latter has been producing between 500M to 1,000M f.b.m. during the last five years.

However, lumbering, fishing and agriculture, besides certain aspects of the Metis' cultural background, have one pronounced barrier to overcome. This is the lack of development and extraction roads into these areas. In the main these are passable only in the winter. In the face of this one must expect that a considerable period of time will have elapsed before any of these resources can make a significant contribution to the north.

This, then, is the situation in general terms insofar as the resources potential of the area is concerned - and against this general background have come the two broad groups of disturbing factors mentioned in the introductory part of this paper (i.e., (a) the activities of the mining and tourist interests and (b) the planned programs of government).

Of the two, the endeavours of private enterprise have had a less pronounced immediate effect than those of the provincial government. This is due mainly to the fact that these activities are limited to three major areas - i.e., Flin Flon and Athabasca (mining), and La Ronge (tourism). The main effect introduced by mining and tourism has been to encourage an influx of white settlement into the areas involved. Along with this has occurred some local migrations of Metis and Treaty Indians (to these areas) and with these shifts in population, there has been an attendant impact upon the social structure of the immigrant native.

The planned programs of the government have had more obvious and more direct effects on these people. The greatest change which appears to have occurred, is in population numbers - particularly as this is related to the capacity of the available fish and fur resources to support these numbers. Heretofore, government interest in these people was rather casual, and as such it is not known what their numbers were in the past. It is difficult, therefore, to say what has been the actual rate of increase over the past ten years. That it is pronounced and even serious can be educed from the following facts which were shown by a population count carried out in 1951 by one of the authors of this paper. (Figure 1)

This study showed, for example, that 52 per cent of the population is under sixteen, that 23 per cent is under six. In contrast to the size of the average Canadian family (3.8), the Metis family has an average size of 5.2. In this respect we have only considered those children who are still dependant upon the parents - i.e., those under sixteen. Another interesting set of facts is exhibited in Table I. Among other things, it shows that the average Metis

TABLE I

The Average Number of Living Children of Metis Women Between the Ages of 16 and 40

Age of Mother	Average Number of Living Children
16	.13
20	.54
21	1.4
24	2.6
28	3.2
30	4.0
33	5.4
36	6.4
40	4.8

girl has her first living child somewhere in her twentieth year (the average age for Canada is twenty-eight).

Earlier we suggested that this apparent rise in population numbers had certain serious ramifications. Ignoring for the time being the catalytic changes wrought upon the social structure (the role of the family in particular) the most obvious aftermath has been an obligatory increase in government expenditures conditioned by its "humanity first" program. In the period 1948 to 1951, for example, the amount of social aid paid to these people increased over 40 per cent.

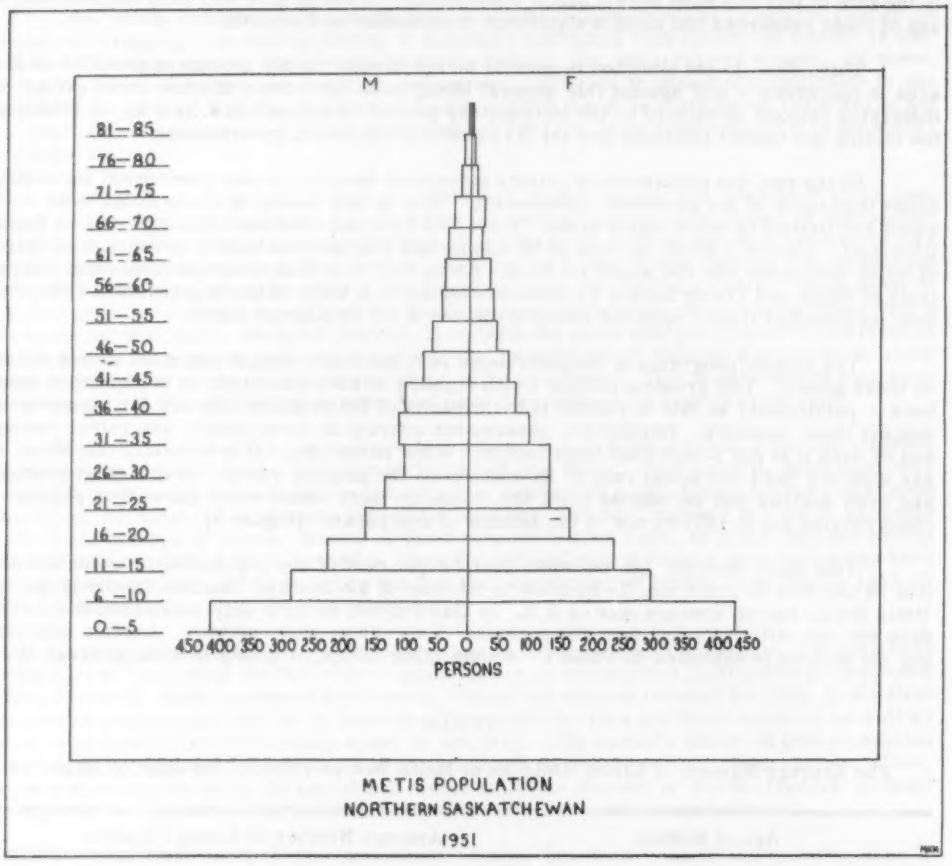


Figure 1.

It is difficult to estimate the annual per capita expenditure by the government in furthering its medical, social services, educational and resources management programs in the area. The sum total of the budgets for the government agencies involved, indicated a per capita expenditure of $100 in 1953 for the people in the north. This is not much more than the per capita expenditure for the province. However, those of us acquainted with the north are inclined to regard this figure with some reservation because it includes the 2,600 whites situated therein (excluding Uranium City and environs) as well as the 3,600 Metis. We know that the average white person in the area is fairly industrious and rarely, if ever, is he the recipient of direct government assistance.

However, as stated before, it is difficult to assess accurately the amount of monies actually expended upon the Metis residents of Saskatchewan's north. Suffice it to say that in all likelihood it exceeded the above mentioned $100, and as such, is greater than the provincial average. These increased government expenditures on behalf of the northern Metis reflect, among other things, a decided inadequacy of the currently utilized available resources to maintain the Metis population at even a static level of subsistence. Let us not overlook the fact that this group of people is dependant on fur for at least 90 per cent of its cash income. Heretofore, beaver was regarded as the most important contributor to the income received from fur. Table II shows what has happened to this source of income.

TABLE II

The Number of Beaver Taken, with the Average Price Per Pelt, 1947-1953

Year	Number of Beaver Taken	Average Price Per Pelt
1947-48	1,801	$ 33.56
1948-49	4,515	19.86
1949-50	8,093	24.33
1950-51	10,517	21.67
1951-52	--	15.76
1952-53	--	15.03

From these figures two facts are observed. The average pelt price of the beaver has dropped from $33 to $15 in six years, while at the same time the total recorded catch has jumped from around 1,000 to over 10,000. From these it would appear that there is a definite peak contribution to the total income which the beaver can make. We would suggest this figure is somewhere between $160,000 to $200,000. There are some fairly valid reasons for this observation. It is a known fact that other game administrations elsewhere in Canada have also sponsored active muskrat and beaver conservation programs. The result has been a marked increase in the production of beaver pelts during the period in question with a consequent decline in the value of the pelt.

The fact that beaver does appear to have a maximum contribution becomes more grave if, as we suspect, the population of the Metis people is actually rising. Obviously the greater the number of people there are, the less will be the share to each.

Perhaps at this point some endeavour should be made to explain the reason for this increase in Metis numbers. That these people begin reproducing early in life and frequently in life, is shown by figures given earlier in this paper. It is suspected that in years gone by, the total number was not affected too much because of the accompanying high death rate. However, within the last ten years certain measures have been introduced among these people which have served to interrupt this "natural balance". Briefly recapitulating these are:

a) The construction of hospitals at such places as Cumberland House, Stony Rapids, Uranium City, etc.

b) The establishment of T.B. and V.D. surveys.

c) The stabilization of income through the activities of government marketing agencies like the Fish Marketing Service and the Fur Marketing Service.

d) The introduction of a regular scheduled service of air travel from all parts of the north to La Ronge, and the establishment of the Air Ambulance Service. This has served to bring a great many ailing people to Prince Albert for medical treatment.

THE SOCIAL ENVIRONMENT

Briefly then, the situation from an economic point of view in the north appears to be one of too many people depending upon insufficient resources - in this case fur and to a lesser extent fish.

Were these folk of the same cultural background as the people who are responsible for administering them, the problem would be much less complex. The remedial program could be clearly divided into two phases. The first of these being designed to cope with the immediate future by taking the pressure off fur. This could be done by getting some employment in the

tourist field or with the companies actively exploring the province's mineral potential. In part, too, it could be accomplished by stimulating interest in agriculture and in the utilization of the available timber resources.

The second phase of this program would be the long-term plan in which various steps could be taken to assist in the rehabilitation of these people in order that they might (if they so wished) leave the area to take employment in their newly-acquired trades in the southern part of the province. However, these people do not have the same cultural background as the white administrator and as such, the application of the above two-fold program is made exceedingly more difficult.

The Metis has a philosophy towards life which in many respects is almost antithetic to that of the white man. Where the white man will endeavour to budget his income to meet future exigencies (foreseen or otherwise), the Metis - on the surface at least - appears unwilling to do so and has been observed to "blow" his money on all manner of things - liquor being among the foremost.

It is impossible in a short discourse such as this to present any detailed explanation for this difference. In part at least, it stems from the initial demands which the average Metis expects from life. Where the average city dweller in Canada hopes for such things as a comfortable home, complete with the latest conveniences, a wide variety of foods, etc., the Metis has much less complex requirements from life. The whole of his existence is based on mobility. His home is a rude log hut with only the barest essentials in way of furniture and other household supplies. His material goods are such that they can be packed almost on a moment's notice and loaded into a canoe.

His food requirements, too, are infinitely more simple. Lard, tea, flour and tobacco represent the most common items purchased in the store. Flesh is provided by animals trapped on the line, or from fish. Once his basic requirements have been met, any additional money that may be left is used for entertainment. The idea of saving money for a "rainy day" is foreign to these people. Indeed, I doubt if they have in their cultural background the concept of a rainy day.

One of the curious aspects about the attitude of these people to money is the way in which prestige is acquired from it. The adult male Metis established his status in the eyes of his fellows, not by acquiring money, but in disposing of it. This also applies to material goods such as clothing, hunting and fishing equipment. In this trait one is reminded of the "Potlatch" of the Indians of the Pacific northwest.

One of the ways used in disposing of his money, and thereby establishing his social position, is through the purchase of liquor. There are no exact figures to be had illustrating the total picture in this respect, but a survey completed by the provincial anthropologist in one community showed that something like one-third of the family income was spent in buying beer during the year 1953. The significant fact here is not the amount of liquor consumed (for alcoholism is rare among these people) but rather the amount that is purchased and given away. The same type of reckless attitude shows through in their gambling.

The characteristic of conspicuous consumption can be seen further in Table III which gives the expenditures made by Metis in a general store in northern Saskatchewan. Notice the inordinate percentage spent on tobacco and dry goods.

TABLE III

Proportion of Metis Expenditures on Certain Commodities

Commodity	Percentage of Income
Drugs and Sundries	0.17
Tobacco	8.1
Groceries	45.5
Hardware	14.1
Gas and Oil	5.8
Dry Goods	26.0

There are other features in the social framework which prohibit these people from accumulating wealth in terms of material goods. The kinship bonds are quite pronounced and also quite extended, and an individual is obliged to extend assistance to the members of his "family". There is a practical function met by this trait. None of these people knows when he or she will be in need of assistance and to refuse aid to any member of one's kinship group is to invite like treatment in his or her time of need.

Another facet of their life which makes rehabilitation a complex matter is their idea of what constitutes work. It is commonly agreed by most mining companies that Metis labour is unsuitable because of their unreliability. Once a Metis labourer has acquired a few dollars it is a common practice to disappear for a few days and return only after his money has been spent. It is obvious that no company can function efficiently with personnel of this type.

This is not to say that these people are lazy - far from it. It simply means that they have a different attitude as to what actually constitutes work. These people acquire no status in the eyes of their fellows, nor do they place any social value upon such qualities as steadfastness and punctuality. He cannot be counted upon to subscribe to a 40-hour week even at attractive wages for any lengthy period. Yet paradoxically enough this same individual thinks nothing of spending weeks on the trap line in sub zero weather in order to earn as little as $100 for a winter's trapping. Again it is a matter of prestige. A good Metis is ipso facto, in the eyes of his people, a good trapper, a good spender and has a good credit rating. At this point one may wonder if there is any partial solution to be offered by migration out of the area. The attached population pyramid shows that there is a pronounced decrease in the age grades from 21 to 29. It would appear then, that migration does occur but for a limited time only. Apparently some of the younger Metis leave their home communities for economic reasons, and it is quite likely they return for social reasons. Undoubtedly during their sojourn in the south they are confronted by a good deal of prejudice on the part of the white people, based not only on cultural differences, but also upon educational differences.

Perhaps the greatest paradox to be found in this whole complex affair is the fact that according to the standards of quality setforth by the fur industry, the Metis trapper is a poor one. He is also an inefficient one.

To be a good as well as an efficient trapper in northern Saskatchewan, requires the attention of the individual thus employed for a period up to ten months in the year. He must devote time to the repair and maintenance of his equipment and his cabins along the line. He must also lay in food supplies for himself, as well as his dogs. This latter he acquires through catching and drying fish. In effect it is a business with a great many details to care for.

The average Metis trapper devotes little time to pre-planning his next winter's trapping. Very often he ventures on to the trap line with little equipment or food and poorly cared for dogs. Not too many of these people fully understand the method of grading pelts employed by the fur trade, and as such, a great many of the furs turned in by them are poorly prepared.

In way of summary then, the Metis people of northern Saskatchewan are increasing at a rate which threatens to outstrip the ability of their fur and fish resources to support them. Though their physical environment leaves something to be desired, it is not the determining factor which makes the situation a grave one. Instead the barriers to a solution to this dilemma are to be found within the cultural framework of these people.

It will be agreed that the problem for the Metis is a confusing one, and undoubtedly he is faced with a painful period of rehabilitation. To suggest that most of them can do other than change from their traditional life is wishful thinking, for the change has already begun to occur. The role of the older folk in the community is changing from that of an authoritarian one to that of an advisor. The solidarity of the family is weakening with the periodic migrations of the men-folk to the "outside". The establishment of schools, hospitals and conservation officer headquarters in the various settlements of the north, is beginning to crystalize more native settlement around these centres. Thus, trapping is becoming less of a family affair than it was.

It is obvious that the factors of time, patience and understanding provide the essence of the ultimate solution. It must be remembered that the dilemma of the native is not as

clearly seen from his point of view as it is analyzed by the administrator. In addition to the forces of supply and demand, the native's perspective must become warped as he views the incomprehensible and inexorable disintegration of his traditional way of life. He sees his children coming home from school parroting strange ideas and often in a strange language. He is informed that his methods of trapping could be improved in order to provide a better product. In some places he is finding that game is not as abundant as it was in former days, and he is not allowed to wander in search of it outside his conservation area.

To some this may appear to be a sad development, but surely none can say that this transitional period is not a necessary step in spite of its painful nature. The function of the administrator during this period is to assist the native as much as possible toward greater adaptation to the dominant cultural environment which is being superimposed upon them.

This whole process must be a spontaneous one which sets its own pace. It cannot be forced. These people must be given the opportunity of weighing the facets of their culture with those of the invading one. They must be given the opportunity of selecting, rejecting or modifying the new values which are being presented to them. There can be no undue haste in this process otherwise the native is faced with more confusion and more frustration. In a sense the whole process must be guided by the principle of helping the native to help himself.

THE DEVELOPMENT OF URANIUM CITY

M.K. McCutcheon and R.G. Young

Saskatchewan Department of Natural Resources

In 1952 the town of Uranium City was established in northern Saskatchewan. Much has been written about the town in popular magazines, but this material deals mainly with the fabulous uranium strikes that have been made in the area, with the fortunes that have been won and lost, with the eccentric characters whom one meets in such pioneer areas and with life in general in a frontier town. These articles, while interesting, contain little factual information about the town itself, its establishment or its administration. This paper is designed to present such information.

Uranium City is located near Martin Lake, north of Lake Athabasca at latitude 59° 34' N. and longitude 108° 37' W., about 150 miles from the Saskatchewan-Northwest Territories boundary. (Figure 1) The townsite is situated on the Uranium Road approximately half way between the Eldorado mine site at Ace Lake and the port of Bushell on Black Bay and is actually built on mining claims. In January, 1952, nothing was visible on the site but the surveyors' stakes. Today it is a thriving town of some 700 people.

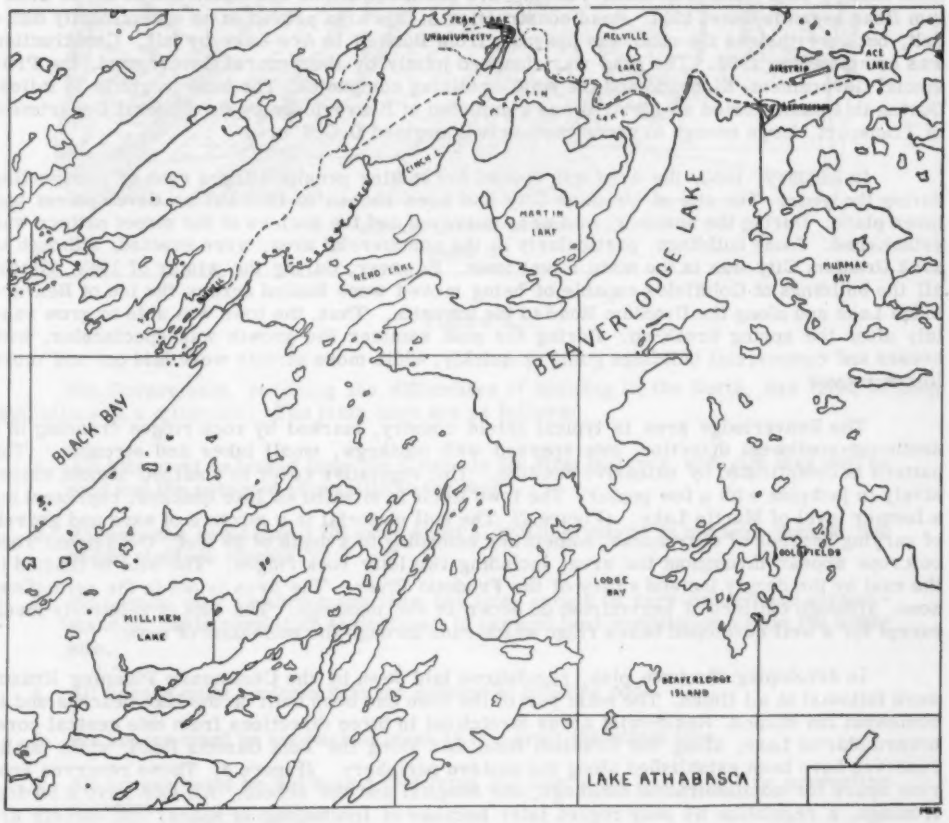


Figure 1. Beaverlodge Uranium Area.

The purpose of establishing a town here was to provide an organizational and service centre for the Beaverlodge uranium area. The mining companies expressed a desire to avoid the expenditure and administrative headaches attendant upon the establishment of a company town; so it was decided that a town would be developed under government auspices. If no such action had been taken and if several mines had developed in the area, each mine would have to have had a small town clustered around the mine shaft and the problems of educational services, hospital and health services, retail merchandising and banking, etc., would have been multiplied. In addition the town serves as a base for further exploration of the area.

The Beaverlodge area was not entirely undeveloped prior to the establishment of Uranium City. In the 1930's several gold strikes were made in the area and in 1938 the Consolidated Mining and Smelting Company completed a 1,000-ton-a-day mill on their Box Mine property and commenced mining and smelting operations. Concurrently, the town of Goldfields was developed on Lodge Bay near the Box Mine. The mine operated during World War II, but because the ore was rather low grade, operations ceased in the post-war years. Goldfields began to decline in population and in 1948 the town was disincorporated, the land reverting to the Crown.

Meanwhile in 1946 Eldorado Mining and Refining Corporation, a Federal Crown Corporation, began exploratory work in the area for radio-active minerals. A small community called Beaverlodge was developed to serve as a base. In 1950 it was decided that a large enough ore body had been determined to warrant mining; so work commenced on the sinking of mine shafts. This made it necessary to improve communications and construction of the Uranium Road began in June, 1951. Road construction in this area proved to be exceptionally difficult, but nevertheless the road was passable from Bushell to Ace Lake by fall. Construction was completed in 1952. The road was financed jointly by the Federal Government, the Provincial Government, Eldorado and the smaller mining companies. The total length is 14 miles. During this same period an airstrip was completed at Beaverlodge by the Federal Department of Transport, large enough to accommodate twin engined D.C.3's.

In January, 1952, the area was opened for staking precipitating a rush of prospecting during the year. The site of Uranium City had been chosen in 1950 but no development had taken place. During the summer, lots were surveyed and the nucleus of the street pattern was established. Some buildings, particularly in the commercial area, were erected, although in 1952 Uranium City was in the main a tent town. However, during the winter of 1952, almost all the buildings at Goldfields capable of being moved were hauled across the ice of Beaverlodge Lake and along the Uranium Road to the townsite. Thus, the town was able to grow rapidly after the spring break-up. During the past summer the growth was spectacular, with houses and commercial buildings going up quickly, while more streets were laid out and more lots surveyed.

The Beaverlodge area is typical shield country, marked by rock ridges trending in a northeast-southwest direction, interspersed with muskegs, small lakes and streams. The pattern is complicated by extensive faulting. The vegetative cover is confined almost exclusively to jackpine with a few poplar. The town itself is situated on lake beaches, representing a former level of Martin Lake. (Figure 2) The soil material is a mixture of sand and gravel, of varying degrees of coarseness, sometimes extending to a depth of 20 feet. Occasional rock outcrops appear throughout the area, including two lofty rock ridges. The site is limited to the east by the deeply incised valley of the Fredette River. The area is not in the permafrost zone, although outliers of permafrost do occur in the muskegs. The site is relatively level, except for a well developed beach ridge which runs through the main part of town.

In developing the town plan, regulations laid down by the Community Planning Branch were followed at all times. The main part of the town has been built on the lake beaches and is somewhat fan shaped. Residential areas stretch out in three directions from this central core, toward Martin Lake, along the Uranium Road and along the Beta Gamma Road, while public reserves have been established along the eastern periphery. (Figure 3) These reserves provide space for administration buildings, the hospital and the school. All lots have a 50-foot frontage, a regulation we may regret later because of limitations of space. All streets are boulevarded, with trees left on the centre strip, except in the business section where they are being removed to provide parking space. The only trees which may be removed are those necessary to make space for a building. The reasons for this regulation is to prevent soil

blowing and to preserve aesthetic values. However, the jackpine is particularly dry and therefore adds greatly to the fire hazard; so this regulation may be relaxed somewhat.

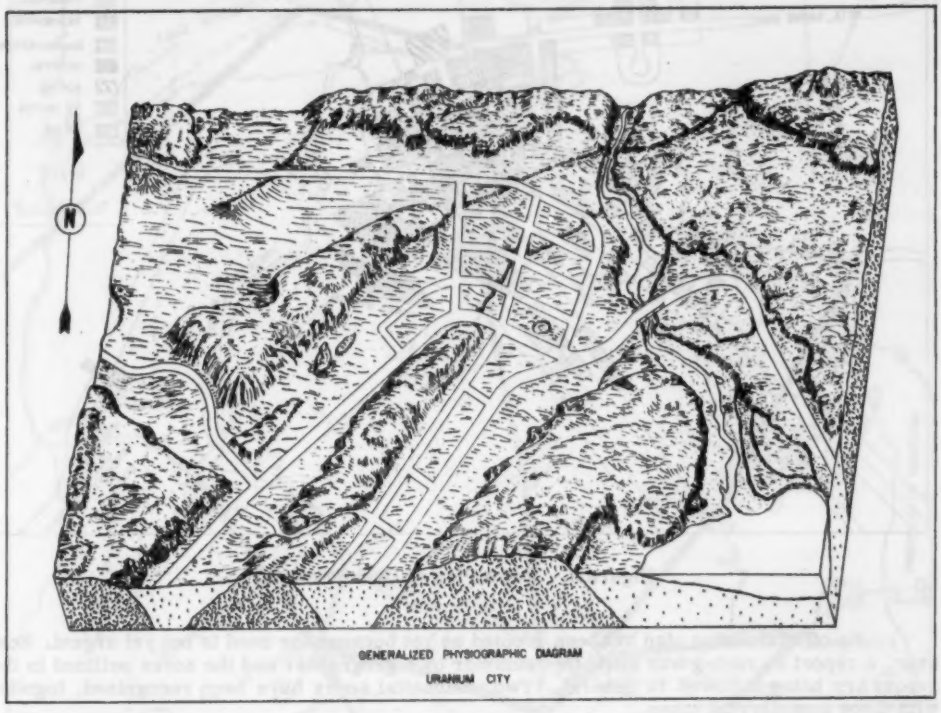


Figure 2.

The Government, realizing the difficulties of building in the North, has tried to keep regulations at a minimum. The main ones are as follows:

1. All lots must be leased from the Crown in the first instance, although they will be sold and the occupant given title to the land.

2. All persons acquiring a lot must erect a dwelling valued at not less than $3,000 within eighteen months.

3. No person may acquire more than two lots, except in very exceptional circumstances. This regulation is designed to prevent land speculation within the townsite.

4. All houses must conform with the provincial building code.

5. All houses must be set back at least 10 feet from the street line.

6. All houses must be set back 5 feet from the lateral lot line as a fire prevention measure.

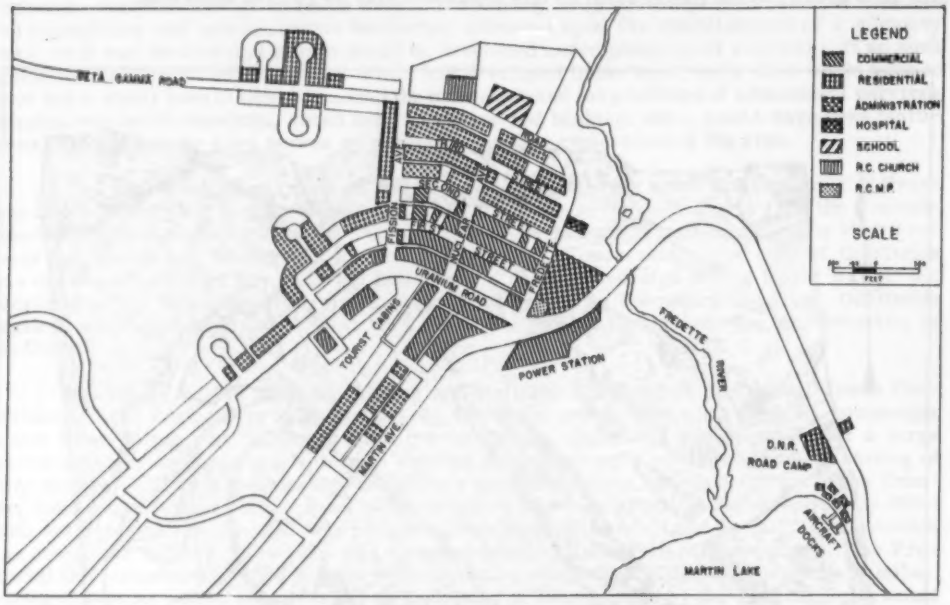


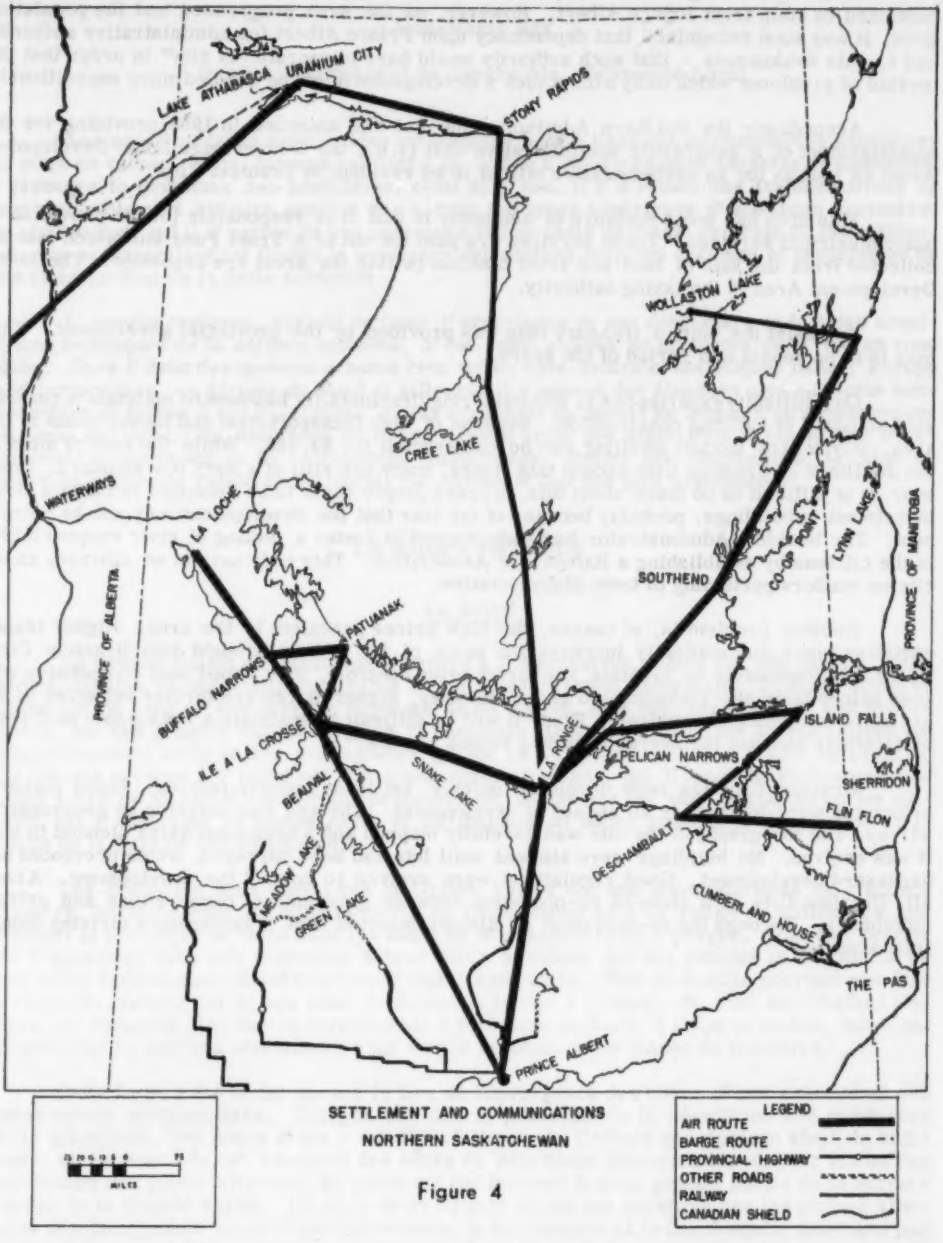
Figure 3. Town Plan of Uranium City.

No official zoning plan has been adopted as yet because the need is not yet urgent. However, a report on zoning was made this summer by a geographer and the zones outlined in this report are being followed in general. Two residential zones have been recognized, together with three commercial zones.

Because of topographical difficulties, the townsite could not be located on the shore of Martin Lake. The presence of the deep gorge of the Fredette River, together with rock outcrops has effectively barred the way to lakeward expansion. However, a few sandy beach lines occur along the lakeshore about a half a mile from town and a small development is taking place here. Docks for water based aircraft are maintained by Saskatchewan Government Airways and McMurray Air Services. These aircraft perform an essential service in supplying isolated mining camps. Indeed, the development of the area would be almost impossible without them. Some of the drilling companies maintain warehouses at this site.

It is unfortunate that, because of the lines of communication, Uranium City is oriented not to Saskatchewan but to Alberta. The only connection with Prince Albert is by air, and a year round service is maintained on this route by Saskatchewan Government Airways. (Figure 4) The area is also connected to Edmonton by Canadian Pacific Airlines. However, all heavy freight and non-perishable items come by rail from Edmonton to Waterways and thence by barge across Lake Athabasca to Bushell. Thus, most of the trade of the town is through wholesale firms in Edmonton. This route is only operative during the summer months, of course.

Considering that the town has scarcely been established for two years, a respectable development has taken place. The permanent population is 714 by the latest count, with a much higher summer population. There is quite a large commercial area, including a 50-room hotel, two banks, three general stores, five restaurants, two clothing stores, two hardware stores, two lumber yards, two garages, two butcher shops, a bakery and many smaller establishments. The town even has two weekly newspapers. A hospital has been completed, a power system installed and regular water delivery and garbage disposal instituted. A four room school and a teacherage were also built during 1953.



SETTLEMENT AND COMMUNICATIONS
NORTHERN SASKATCHEWAN

Figure 4

From the point of view of municipal development, settlement in Saskatchewan's shield area is at a fairly simple stage. Thus, it is possible to attend to the task of municipal administration from the departmental office in Prince Albert. (Such municipal services are provided under the jurisdiction of the Northern Administration Act.)

In the initial stages of development of the Beaverlodge area, administrative services continued to stem from Prince Albert. However, as the area progressed and the population grew, it was soon recognized that dependency upon Prince Albert for administrative authority had certain weaknesses - that such authority would have to operate "in situ" in order that the myriad of problems which daily attend such a development might be handled more expeditiously.

Accordingly the Northern Administration Act was amended in 1953 providing for the establishment of a geographic administrative unit (i.e., the Beaverlodge Local Development Area) as well as for an administrative officer to be resident in Uranium City.

This area has some measure of autonomy in that it is responsible for the provision of basic municipal services. These services are paid for out of a Trust Fund into which monies collected from the sale of land and from taxation (within the area) are deposited. The Local Development Area is the taxing authority.

To assist the unit, a treasury loan was provided by the provincial government. This loan is to be repaid in a period of ten years.

One difficulty experienced in administering Uranium City has been to maintain a reasonable standard of building construction. Because of high transportation and labour costs in the area, only a very modest dwelling can be constructed for $3,000. While the cost of most of the dwellings at Uranium City exceed this figure, many are still of a very low standard. However, it is difficult to do much about this, because people seem to be reluctant to make a large investment in buildings, probably because of the fear that the development may not be permanent. The Resident Administrator has endeavoured to foster a feeling of civic responsibility in the citizens by establishing a Ratepayers Association. This body acts in an advisory capacity on matters pertaining to town administration.

Another problem is, of course, the high prices prevalent in the area. Higher transportation costs automatically increase the price of any article brought into Uranium City. While it is impossible to institute any direct price controls, it is hoped that competition will keep prices from sky-rocketing too high. However, higher prices are further reflected in the provision of municipal services. Thus, it will be difficult to maintain a reasonable mill rate, particularly because the average building values are low.

Uranium City has been developed quickly, but in an orderly fashion. Sound planning principles were followed in all phases of development. The site was selected by geographical survey. The topography of the site was carefully mapped and a town plan which blended in with it was evolved. No buildings were allowed until lots had been surveyed, which prevented any haphazard development. Good regulations were evolved to control the development. Above all, Uranium City is a story of co-operation between government, corporations and private individuals. Through the co-operation an almost deserted land is becoming a thriving industrial area.

LA GRANDE VALLEE DE CALIFORNIE

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Les zones arides et semi-arides ont toujours posé à l'homme de redoutables problèmes de mise en valeur. Mais, lorsque celui-ci a pu, grâce à des techniques savantes et élaborées, y résoudre le problème des problèmes, celui de l'eau, il y a réussi des tranformations de paysages nulle part ailleurs égalées et y a crée des types supérieurs d'économie agricole et de civilisation, qu'il s'agisse de ces anciennes villes-oasis de l'Asie centrale, de cette Mésopotamie sur laquelle s'est fondée la puissance des anciens empires chaldéen et assyrien ou de ces cités-jardins de la Syrie orientale.

L'homme moderne, enrichi de toute l'expérience de ses devanciers et fort des acquisitions techniques de la science moderne, s'est aussi attaqué au problème de la vie en zone sèche. Dans l'Asie des moussons aussi bien qu'en Asie centrale soviétique, dans l'Europe méditerranéenne, en Afrique du Nord et ailleurs, il a annexé des étendues plus ou moins considérables de terres à son oecoumène, en les arrachant au désert au moyen d'un aménagement rationnel des eaux. En Amérique du Nord, l'Ouest aride des Etats-Unis a été le lieu d'expériences audacieuses et de réalisations magnifiques. Parmi ces réalisations, la mise en valeur de la Grande Vallée de Californie est sûrement une des plus grandioses.

LE MILIEU PHYSIQUE

Le Relief

La Grande Vallée de Californie s'impose à l'observateur, même sur une carte à petite échelle, comme un des traits marquants du relief de l'Ouest américain. Profond sillon de 400 milles de long, d'une largeur moyenne de 50 milles, elle est, avec ses 20,000 milles carrés, une des grandes vallées du globe et contraste étrangement avec les autres vallées qui compartimentent cette région montagneuse qu'est la Californie. Axe de l'Etat californien, elle déroule presque à l'infini ses immenses surfaces planes, qui l'opposent violemment aux hautes surfaces au relief tourmenté, profondément buriné par les eaux courantes ou les glaciers, qui l'enserrent de toutes parts et lui forment un décor continu, à l'exception de la brèche de la Baie de San Francisco.

Les géologues nous disent que la Grande Vallée est une zone déprimée de l'écorce terrestre, analogue sous certains rapports au Puget Sound et à la vallée du Willamette, qui semblent la prolonger au Nord dans les Etats de Washington et de l'Orégon. Par son origine elle s'apparente donc aux nombreux autres blocs affaissés qui ont ponctué la dislocation de cette terre éminemment instable qu'est l'Ouest américain. Elle ne semble pourtant pas être un véritable graben, car si une zone de failles la limite à l'Ouest, du côté des Chaînes Cotières, en revanche, les hautes surfaces qui l'enclosent au Nord, à l'Est et au Sud, semblent plonger sous le manteau sédimentaire qui emplit la fosse, sans traces de fractures.

Cette fosse a été et est encore le lieu de convergence des cours d'eau descendant des hautes terres environnantes. Chargés des débris provenant de la démolition des montagnes qu'ils affouillent, ces cours d'eau y ont déposé depuis le Crétacé une épaisse série de sédiments, et, surtout, ils ont construit des cônes de déjections débordant les uns sur les autres pour donner des glacis alluviaux de piedmont qui forment la plus grande partie de la surface actuelle de la Grande Vallée. Le reste de la Grande Vallée est constitué par les plaines alluviales des deux grands cours d'eau collecteurs, le Sacramento et le San Joaquin, ainsi que par le delta qu'ils ont édifié conjointement dans la région de la Baie de San Francisco.

La Grande Vallée de Californie comprend trois bassins de drainage, de superficie à peu près égale: au Nord, le bassin du Sacramento; au Centre, celui du San Joaquin et au Sud, le bassin de Tulare. Les deux premiers ont à peu près les mêmes caractéristiques, mais celles-ci sont accentuées par la sécheresse dans le bassin du San Joaquin. C'est ce qui y ex-

plique le grand développement des cônes de déjections et aussi la surcharge en matériaux de la rivière principale qui l'oblige à faire de nombreux méandres et à se diviser en plusieurs bras.

Le bassin de Tulare est un bassin de drainage interne. Il doit son entité à la présence du puissant cône alluvial de la rivière Kings, qui, au Sud de Fresno, s'est allongé à travers l'axe de la vallée, bloquant ainsi tout écoulement vers la mer. Plus au sud, le cône de la rivière Kern a également obstrué le drainage de la vallée et contribué à l'individualisation des bassins des lacs Kern et Buena Vista.

Climat

Le climat est l'élément le plus caractéristique du milieu naturel de la Grande Vallée. Les propriétés de ce climat découlent de l'inter-action de facteurs généraux et locaux.

Le facteur le plus important se trouve dans les conditions générales de la circulation atmosphérique planétaire. En effet, la Grande Vallée, située sur la côte ouest du continent nord-américain, entre le 35e et le 40e parallèle, se trouve sous l'influence directe du maximum du Pacifique Nord. Ce centre de hautes pressions, qui émigre avec le soleil, remonte en été vers le Nord et envahit le continent. Il agit ainsi à la façon d'un môle qui empêche l'arrivée des dépressions cycloniques du Pacifique et fait régner sur la Californie du Centre et du Sud un air descendant, sec et clair. Durant la saison chaude, la Grande Vallée, aussi bien qui la Californie du Centre et du Sud, est ainsi annexée à la zone désertique des hautes pressions subtropicales et jouit d'un climat sec et chaud.

En hiver, au contraire, ce centre de hautes pressions descend vers le Sud, de sorte que la Grande Vallée, avec le reste de la Californie du Nord et du Centre, est rattachée à la zone des vents d'Ouest pluvieux. Les dépressions cycloniques du Pacifique peuvent alors l'envahir et lui apporter de la pluie. L'hiver est donc la saison pluvieuse.

Eté sec, hiver relativement pluvieux. Voilà la caractéristique fondamentale du climat de la Grande Vallée, qu'elle partage avec les autres régions de même latitude de la côte du Pacifique, et qui la rattache au type de climat méditerranéen. Ainsi la pluviosité moyenne de Fresno est de 0.10 pouce en juin, 0.08 en juillet, 0.00 en août, 0.07 en septembre, mais de 1.19 en décembre, 1.37 en janvier, 1.61 en février et 1.09 en mars.

Un autre facteur très important du climat de la Grande Vallée est la présence d'une barrière montagneuse presque continue à l'Ouest, du côté du Pacifique. Cette barrière montagneuse joue le rôle d'écran qui empêche la pénétration des influences océaniques dans la Grande Vallée et limite le climat maritime à une mince frange littorale. Cet écran montagneux a pour effet de donner au climat de la Grande Vallée une nuance continentale en ce qui concerne les températures, et surtout d'y accentuer la sécheresse.

La continentalité y est surtout marquée en été. Soustraite à l'influence modératrice de la mer, la Grande Vallée connaît des températures diurnes beaucoup plus élevées que les stations de la côte. Ainsi Sacramento a une moyenne de juillet de 73.9° F., alors que San Francisco a 58.9° F. Salinas, sur la côte, a 63.3° F. tandis que Fresno atteint 81.3° F. A peu près toute la Grande Vallée a une moyenne de juillet supérieure à 76° F.; le Sud de la Vallée du Sacramento et la plus grande partie de la Vallée du San Joaquin ont des moyennes de juillet supérieures à 80° F., tandis que la région de Bakersfield, dans le bassin de Tulare, connaît des moyennes de juillet supérieures à 84° F.

Si l'écran des Chaînes Côtières fait régner des températures torrides, en été, dans la Grande Vallée, il y accentue aussi la sécheresse. La Côte californienne aux latitudes de la Grande Vallée ne reçoit jamais moins de 20 pouces d'eau par an, et, dans le Nord, en reçoit jusqu'à 70 et 80. Au contraire, la plus grande partie de la Grande Vallée reçoit moins de 20 pouces; ce chiffre s'abaisse à 15 pour la Vallée du San Joaquin, alors que le bassin de Tulare doit se contenter de moins de 10 pouces.

Tels sont les caractères généraux du climat de la Grande Vallée de Californie. Le développement en latitude, l'altitude, la continuité et la hauteur de l'écran montagneux intro-

duisent des nuances régionales. Dans l'ensemble, la Vallée du Sacramento, plus au Nord, est moins chaude que la Vallée du San Joaquin et à fortiori que le bassin de Tulare. Ainsi Sacramento a une moyenne de juillet de 73.9° F., tandis que, dans le comté de Kern, Bakersfield a 83.5° F., Dudley 85.4° F., et Edison 87.3° F. De même la Vallée du Sacramento est plus arrosée qu celle du San Joaquin et du bassin de Tulare. La moyenne annuelle de Folsom est de 23.67 pouces, celle de Sacramento, 15.88 pouces; mais cette moyenne s'abaisse à 9.43 pouces à Fresno et elle n'est que de 6.12 pouces à Bakersfield. On peut résumer en affirmant que les chaleurs de plus en plus fortes et les précipitations de plus en plus faibles donnent une teinte de plus en plus désertique au climat de la Grande Vallée au fur et à mesure que l'on descend vers le Sud.

Végétation

Sous un tel climat, la végetation ne peut être que steppique: "Touffes d'herbes vertes en hiver, fleuries au printemps, mais desséchées en été".[1] Les variétés régionales du climat, la constitution des sols et la proximité de la nappe phréatique introduisent des nuances parfois importantes. Les bassins inondables, par exemple, au sol marécageux, caractéristiques des parties basses du delta et des plaines alluviales du Sacramento et du San Joaquin, portaient une végétation de roseaux, les "tule", qui a valu à ces zones basses le nom de "tule basins". Dans le Sud, au climat désertique, les fonds de lacs desséchés montraient de grandes surfaces dénudées aux efflorescences salines. Sur la pauvreté de la végétation du Sud de la Grande Vallée nous avons le témoignage du général Bennet Riley. A la vue du bassin de Kern, il écrit, en 1849, que ce bassin était "so barren as scarcely to afford subsistence for our animals, and can never be of much value for agricultural purposes".[2]

PEUPLEMENT ET MISE EN VALEUR

Le peuplement et la mise en valeur de la Grande Vallée de Californie furent très tardifs, comme ce fut d'ailleurs le cas de tout l'Ouest américain. Mais dans le cas de la Grande Vallée, des raisons spéciales tenant et à la nature des premières tentatives de peuplement de la Californie et aux conditions particulières du milieu y retardèrent davantage la poussée colonisatrice. On peut distinguer trois périodes principales de mise en valeur: (a) une période ancienne, allant de l'occupation espagnole aux années 1870; (b) une seconde période, s'étendant de 1870 à 1935; (c) la période actuelle, à partier de 1935.

Première Periode

Il est assez étonnant de constater que la Grande Vallée, qui allait devenir une des régions agricoles les plus riches des Etats-Unis, ne sut pas pendant de longues années attirer l'effort colonisateur. Cet état de choses s'explique par plusieurs facteurs. Les premiers tiennent à la nature des premières poussées du peuplement en Californie.

Les Espagnols et les Mexicains, intéressés presque exclusivement à tenir la côte californienne dans le but de protéger la route des gallions entre Manille et Acapulco, ne s'occupent guère de mettre en valeur l'intérieur du pays. Aussi se contentent-ils de diviser certains secteurs de la Grande Vallée en immenses "ranches" où se pratique l'élevage extensif des bovins, dont la peau et la moelle constituent des articles d'exportation. Et pourtant si jamais un groupe humain fut en mesure de mettre en valeur cette zone aride et semi-aride qu'est la Grande Vallée, ce fut bien les Espagnols et les Mexicains. Mais il semble que la grande faiblesse de la colonisation espagnole fut le manque d'hommes.

Quoiqu'il en soit, la situation en est là lorsque s'ouvre l'époque trépidante de la ruée vers l'or, en 1848. Des nuées d'aventuriers s'abattent sur la Californie, mais ils ne s'arrêtent pas dans la Grande Vallée, pressés qu'ils sont d'arriver aux cours d'eau de la Sierra

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[1] Baulig, H.: L'Amérique septentrionale, Tome XIII. Géographie Universelle, 2ième partie, p. 546.

[2] Brown, Ralph H.: Historical Geography of the United States, p. 529.

Nevada qui roulent le précieux métal. La Grande Vallée n'est qu'une zone de passage et il ne fait pas bon de s'attarder dans ce pays désertique et désolé. Aussi, lorsque la fièvre de l'or se résorbe vers 1860, le bilan du peuplement est-il extrêmement maigre: à part quelques établissements nés de la circulation et du commerce, tels que Sacramento et Stockton, la Grande Vallée est aussi déserte qu'auparavant.

Cette situation se comprend facilement. La grande ressource de la Vallée, c'est la terre, c'est le sol. Or les chercheurs d'or de 1848, comme tous les chercheurs d'or, n'avaient pas de vocation manifeste à l'agriculture. Ils venaient en Californie pour bien autre chose que labourer la terre, et les revenus qu'ils pouvaient retirer de l'extraction minière étaient beaucoup plus élevés que ceux qu'ils pouvaient espérer tirer de la culture du sol.

Cependant, en dépit des apparences, l'époque de l'or ne se solda pas complètement par un bilan aussi négatif. En fait, c'est elle qui a fini par révéler les possibilités agricoles de la Grande Vallée. En effet, vers la fin du "gold rush", si la plupart des chercheurs d'or repartirent à la recherche de nouveaux gisements, quelques-uns restèrent, se tournèrent vers le sol et commencèrent à cultiver. D'autres colons suivirent leur exemple. Vers 1869, c'est-à-dire après l'arrivée du premier transcontinental, la Grande Vallée était devenue une vaste terre à céréales, surtout à blé. Ainsi la première période se terminait-elle par une phase agricole de transition.

Deuxième Période

Il ne faut pas conclure au triomphe définitif de l'agriculture ni à une mise en valeur intégrale du sol. On se rendit bientôt compte que la culture des céréales était extrêmement aléatoire sous un climat comme celui de la Grande Vallée. On se demanda aussi si d'autres cultures ne seraient pas mieux adaptées au milieu et ne pourraient pas tirer un meilleur parti de ses conditions favorables, notamment de la longue durée de la saison végétative, des grandes chaleurs et des sols fertiles.

Mais en même temps se posait le grand problème d'une véritable mise en valeur de la Grande Vallée, celui de l'eau. Quelques esprits entrevirent alors que la seule solution adéquate au probleme de l'agriculture résidait dans l'irrigation. C'est la conclusion à laquelle était arrivé le Commissaire à l'agriculture, lorsqu'en 1874, dans un rapport consacré aux conditions du développement de l'agriculture dans la Grande Vallée, il déclare: "The Great Valley is admirably adapted to irrigation on the grandest scale".[1]

Cette constatation éminemment juste n'empêcha pas cependant les débuts de cette agriculture intensive à base d'irrigation d'être extrêmement lents. C'est que la mise sur pied d'un tel type de culture se heurtait à des obstacles nombreux et difficiles à vaincre.

Le premier venait du colon lui-même. Celui-ci, habitué à l'agriculture traditionnelle de l'Est, se trouvait tout à fait désemparé dans ce nouveau milieu: il ne possédait aucune des techniques nécessaires à la culture sans climat aride ou semi-aride. C'est ce que note le Commissaire à l'agriculture: "So great a departure from the climate of the Midwest and East", said the Commissioner of Agriculture, subjected "the culture of the soil to novel conditions, unsettling old traditions, and defying some of the most tenaciously held lesson of experience in the older parts of the country".[2]

Une autre difficulté provenait d'une certaine incertitude au sujet des titres de propriété du sol. Les grandes concessions de terres effectuées sous le régime mexicain et peut-être durant la période d'indépendance avaient été faites grosso modo, sans délimitations bien précises. Il en résulta de nombreuses revendications opposées qui nécessitèrent un arpentage plus rigoureux des terres et une vérification des titres de propriété.

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[1] Brown, Ralph H.: op. cit., p. 531.

[2] Ibid, p. 513.

L' utilisation de l' eau elle-même souleva de nombreuses et violentes controverses légales. Deux droits d' appropriation de l' eau avaient alors cours en Californie. Le premier connu sous le nom de doctrine riparienne reconnaissait à chaque propriétaire dont les terres bordaient un cours d'eau le droit au volume intégral d'une eau dénaturée d'aucune façon. Cette doctrine s' opposait donc à toute déviation d' eau pour fins d' irrigation. Acceptable dans les zones les plus humides de la Californie, elle était tout à fait inadaptée aux conditions régnant dans la majeure partie de la Grande Vallée. Le second, connu sous le nom de "doctrine d' appropriation" reconnaissait au premier usager de l' eau d' un cours d' eau pour fins utiles le droit à un usage continu de cette eau. Cette doctrine, en usage dans les régions minières, était donc favorable à l' irrigation. Elle finit par prévaloir, mais non sans de violentes oppositions.

Enfin, le grand obstacle résidait dans les problèmes mêmes de l' aménagement des eaux. Ce n' était pas une besogne facile à laquelle était convié le colon: il s' agissait de la transformation radicale d' un paysage. Cet aménagement comportait trois aspects principaux: le drainage des régions marécageuses, la prévention des inondations, l' irrigation.

La Grande Vallée connaît cette situation paradoxale, qui d' ailleurs se retrouve en d' autres régions sèches, de souffrir à la fois d' un excès et d' une déficience d' eau. Trop grande abondance d' eau dans le sol de certains secteurs: Cela signifiait qu' avant de corriger l' aridité climatique, il fallait drainer les terres marécageusees. Au début de la mise en valeur de la Grande Vallée, les surfaces marécageuses occupaient de grandes étendues. Il y avait d' abord cette région amphibie du Delta où les inondations périodiques, dues aux fortes marées qui remontaient le Sacramento et le San Joaquin et débordaient les digues naturelles de ces deux fleuves, entretenaient 500,000 acres de sol marécageux.

Venaient ensuite les bassins d' inondation des plaines alluviales du Sacramento et du San Joaquin. Nous savons, en effet, que ces deux cours d' eau et beaucoup de leurs affluents n' ont pas une capacité de transport suffisante pour évacuer tous les matériaux dont ils sont chargés. Ils déposent donc une partie de cette charge dans leur lit et ainsi exhaussent celui-ci. De plus, lors des débordements, le dépôt est beaucoup plus considérable sur les bords immédiats des cours d' eau que dans les parties plus éloignées de leur plaine alluviale. Il en résulte que les rivières coulent au-dessus de leur plaine alluviale, le plus souvent entre des digues naturelles. Les parties basses de la plaine alluviale encloses par les digues naturelles du cours d' eau principal et de ses affluents forment des sortes de bassins déprimés où, lors des crues, s' étalent les eaux d' inondation et d' où elles ne peuvent s' échapper. Le type de ces bassins d' inondation est le Yolo Basin sur la rive droite du Sacramento.

Enfin des zones plus ou moins larges de marécages frangeaient les lacs de playa du bassin de Tulare, zones se rétrécissant ou s' élargissant suivant les oscillations saisonnières et périodiques de ces lacs.

Toutes ces terres, connues sous le nom de Tule Marshes, possédaient des sols qui, une fois drainés, comptèrent le plus souvent parmi les plus riches de la Grande Vallée.

Le travail d' asséchement des marécages commença dans le Delta, entre 1870 et 1875, notamment dans les zones balayées par la marée autour de la Baie de Suisun. A l' aide de digues de 4 à 6 pieds de haut, on arrêta l' invasion des eaux salées de la mer. Puis, on construisit des fossés de drainage pour l' évacuation des eaux superflues. Enfin, on laissa le sol se dessoler graduellement sous l' effet de la pluie et des eaux d' irrigation.

Ce travail de drainage remonta petit à petit les vallées du Sacramento et du San Joaquin, puis finit par s' étendre à tous les coins de la Grande Vallée. Dès avant 1900, le comté de Sacramento comptait 54,835 acres de terres en drainage. La grande époque fut de 1910 à 1919, alors que 624,923 acres de nouvelles terres furent m i s e en drainage. En 1950, la Grande Vallée comptait 1,965,857 acres de terres drainées.

Non seulement la Grande Vallée souffre en certains secteurs d' une trop grande quantité d' eau dans le sol, mais, à certaines époques de l' année, elle doit se prémunir contre une trop grande abondance des eaux courantes, toujours prêtes à déborder le lit des rivières et à s' étaler en inondations désastreuses sur les riches terres en cultures.

Ce danger d'inondations saisonnières est le résultat du tempérament des cours d'eau qui convergent dans la Grande Vallée. En effet, les bassins d'alimentation de la Grand Vallée sont en majeure partie formés de montagnes, dont la puissante chaîne de la Sierra Nevada. Ces hauts sommets interceptent les vents d'Ouest pluvieux, provoquent une condensation qui donne des précipitations considérables. Songeons, par exemple, que la plus grande partie de la Sierra Nevada reçoit plus de 40 pouces d'eau par an et que beaucoup de sommets en reçoivent plus de 70.

D'un autre côté, ces précipitations s'abattent pour la majeure partie durant les mois d'hiver et du printemps, bien souvent sous forme d'averses violentes. Ce régime est donc favorable au gonflement des rivières et aux crues violentes. L'époque la plus dangereuse est le début du printemps, alors que des pluies relativement chaudes se combinent à l'eau de fonte des neiges pour faire monter de façon menaçante le niveau des cours d'eau.

La topographie vient encore aggraver le danger provenant de ce régime des précipitations. Les fortes déclivités des versants montagneux favorisent le ruisselement rapide des eaux sauvages. La forte pente des cours d'eau eux-mêmes dans leur bief montagneux donne lieu à un écoulement extrêmement rapide, à caractère torrentiel. Contenues dans la montagne par les hautes murailles qui les enserrent, ces rivières déversent dans la plaine de véritables avalanches d'eau qui cherchent à s'étaler. Or, dans la plaine, le danger est d'autant plus grave que la plupart de ces cours d'eau, comme nous venons de le voir, coulent au-dessus de leur plaine alluviale. Qu'une crue assez puissante provoque la rupture des digues naturelles, et dans un court espace de temps la crue a donné naissance à une inondation dévastatrice.

Contre cette menace des inondations on a lutté de différentes manières. On a ainsi dépensé des millions de dollars à la construction de digues artificielles ou au renforcement des digues naturelles, au creusement de chevaux latéraux et d'autres canalisations pour hâter l'évacuation des eaux. Ces solutions ne se sont pas révélées très adéquates. Tout d'abord, ces travaux n'ont contenu que des crues mineures. De plus, il y avait quelque chose de tragique dans de telles solutions: on essayait d'accélérer l'évacuation des eaux vers la mer, alors qu'on savait pertinemment combien ces eaux seraient utiles durant la saison chaude pour corriger l'aridité climatique par l'irrigation.

L'irrigation, voilà, en effet, l'aspect fondamental de l'aménagement des eaux dans la Grande Vallée. Le drainage et la prévention des inondations, tout en étant nécessaires, ne s'attaquent pour ainsi dire qu'au côté négatif du problème. L'élément positif, celui qui permettra l'implantation des cultures délicates qui font la richesse de la Grande Vallée, c'est l'irrigation.

L'irrigation trouvait dans la Grande Vallée des conditions dans l'ensemble très favorables. Ces conditions favorables proviennent précisément de la juxtaposition de la montagne et de la plaine, de la structure et de la topographie de la Grande Vallée.

Désastreuse par certains côtes, en particulier sous le rapport des inondations, la présence des montagnes sur tout le pourtour de la Grande Vallée en est en même temps le plus grand bienfait. Sans ces hauts sommets qui vont chercher l'humidité dans les couches supérieures de la troposphère, la majeure partie de la Grande Vallée serait restée le désert que nous décrivent les premiers voyageurs et explorateurs. En effet, les innombrables cours d'eau qui descendent de la montagne sont, une fois déviés vers les terres en cultures, comme autant de vaisseaux sanguins qui vont porter la vie à la plaine assoiffée, pour ainsi dire déshydratée par le soleil implacable qui tombe sur elle. Ce rôle bienfaisant est surtout le fait de la puissante Sierra Nevada. Les cours d'eau qu'elle alimente sont non seulement plus nombreux et plus volumineux que ceux des Chaînes Côtières, mais, propriété entre toutes importantes, ils maintiennent en général un débit convenable durant une bonne partie de l'été à cause de la rétention nivale. Le grand château d'eau, le grand réservoir, il est donc là dans cet énorme bourrelet de la Sierra Nevada. De bonne heure on s'en rendit compte. Dans son rapport de 1874, le Commissaire à l'Agriculture notait: "The great storehouse of moisture is the Sierra Nevada".[1]

Cette eau de surface, la présence des cônes de déjections construits par les cours d'eau descendant de la montagne la rendait facile à capter. On n'avait qu'à barrer le cours

[1] Ibid., p. 514.

d' eau, soit au sortir de la montagne, à l' appex du cône, soit un peu plus bas, à la détourner dans des canaux de dérivation qui la conduisaient par gravité vers les terres basses à irriguer.

Cette abondance des eaux de surface offre un autre avantage: c' est que les eaux ainsi utilisées pour fins d' irrigation sont douces et ne présentent pas le problème des sels dissous qui constituent un danger pour les sols et les cultures.

Bien pourvue en eau de surface, la Grande Vallée possède aussi de riches réserves d' eaux souterraines. La Grande Vallée est une cuvette allongée dont les formations géologiques plongent de tous côtés vers l'axe de la Vallée. Une bonne partie de son sous-sol est constituée de puissantes formations de matériaux meubles et perméables, susceptibles d' emmagasiner l' eau. On estime la capacité d' emmagasiment de tout le bassin à plus de 20 millions d' acres-pied. Ces eaux souterraines ont l' avantage d' être faciles à capter dans la plupart des cas. Cela est encore dû à la présence des cônes de déjections. Dans les matériaux meubles et perméables de ces cônes, une proportion plus ou mains considérable des eaux courantes s' engouffre et voyage souterrainement à peu de profondeur. Parfois, elles sourdent à la périphérie des cônes sous forme de sources; dans la plupart des cas, il suffit de puits ordinaires pour les atteindre. Il n' y a pour ainsi dire que dans l' axe de la Vallée où les nappes phréatiques propres à l' irrigation soient très basses et nécessitent le forage de puits profonds pour leur captation.

Les premiers essais d' irrigation semblent s' être faits dans les secteurs de la rivière Kings et de Fresno. On y trouvait, d' après le professeur Colby, moins de difficultés légales, et, de plus, la culture sèche des céréales s' y était avérée une faillite totale. Ces premières expériences eurent en outre l' avantage d' être entreprises par de petites colonies à structure coopérative qui divisaient entre leurs membres les grands ranches en petits lots adaptés à la culture intensive des fruits. "Ces petites colonies fourniront la communauté d' intérêt et la solidarité dans le travail nécessaires à la construction des barrages et des canaux". [1]

Ces humbles essais furent le début d' un mouvement qui prit peu à peu de l' ampleur et finit par faire de la Grande Vallée la plus vaste région d' irrigation d' un seul tenant aux Etats-Unis. En 1939, soit quatre ans après la fin de notre seconde période de mise en valeur, on y recensait 2,993,321 acres sous irrigation, dont 2,221,377 pour les bassins du San Joaquin et de Tulare, c' est-à-dire près de la moitié du total de toute la Californie.

Il n' entre pas dans le cadre de cet exposé de faire une étude détaillée de tous les aspects de l' irrigation dans la Grande Vallée. Nous nous contenterons de souligner l' incomparable organisation qui a rendu possible cette irrigation et la grande variété des techniques mises en oeuvre.

L' utilisation de l' eau suppose tout d' abord l' existence d' organismes qui ont pour but la captation, l' acheminement et la distribution des eaux. La Grande Vallée possédait en 1935 à peu près tous les types d' organismes, à l' exception des organismes gouvernementaux, depuis la petite entreprise individuelle qui possède ses propres ouvrages de captation et de distribution et en contrôle le fonctionnement, jusqu' aux districts d' irrigation, grandes entreprises coopératives établies en vertu de lois spéciales de l' Etat, en passant par les petites coopératives et les entreprises commerciales. Le type dominant était et est encore l' entreprise individuelle. En 1950, on en recensait 31,457, irriguant 3,258,515 acres.

Les techniques mises en oeuvre pour l'utilisation de l'eau nous étonnent par leur variété. Cette variété des procédés provient en partie des conditions du milieu physique régnant dans les différents secteurs. Ainsi, dans le secteur ouest de la Vallée du Sacramento, où l' eau de surface est plutôt rare, on irrigue surtout à l' aide de puits qui vont capter l' eau souterraine enfouie dans les matériaux détritiques des cônes alluviaux. Dans le Delta, on obtient l' eau en la pompant du lit des cours d' eau ou des fossés de drainage. Le glacis alluvial de l' Est de la Vallée du San Joaquin et du bassin de Tulare reçoit ses eaux par gravité, grâce à des dérivations opérées sur les rivières telles que le Stanislaux, le Merced, le San Joaquin, le Kings, le Tule et le Kern, à l' aide de simples écluses et barrages. Les secteurs Centre-Ouest et Sud-Ouest du comté de Fresno sont arrosés exclusivement au moyen de puits artésiens, très profonds, descendant parfois jusqu' à 2,500 pieds et comportant des pompages de 400 à 600 pieds. En 1949, 1,433 entreprises, desservant 1,110,396 acres, utilisaient des

[1] Ibid., p. 531.

eaux de surface venant par gravité; 1,374, irriguant 522,210 acres, captaient leurs eaux de surface par pompage et 144, arrosant 193,571 acres, obtenaient cette eau par gravité et pompage. Quant aux eaux souterraines, 27,821 entreprises de pompage les distribuaient à 2,424,933 acres. Enfin, 1,112 entreprises, s'approvisionnant et aux eaux de surface et aux eaux souterraines, irriguaient 1,155,679 acres.

Quels que soient les procédés utilisés, la captation et l'utilisation des eaux requièrent un nombre incroyable d'ouvrages de toutes sortes, depuis les barrages de dérivation et les barrages-réservoirs ou les puits jusqu'aux canaux de distribution qui vont porter l'eau à la plante. En 1950, la Grande Vallée comptait 2,696 barrages de dérivation, dont 589 en béton ou maçonnerie, 533 en bois et 1,165 en terre et roc; elle possédait aussi 613 réservoirs. Les canaux et fossés totalisaient 16,591 milles de longueur et les pipelines 2,477. Enfin, le nombre des puits s'élevait à 50,574.

Ces quelques chiffres ne nous donnent qu'une faible idée de tous les ouvrages nécessaires à l'irrigation. Si nous nous rappelons tous les travaux qu'ont requis le drainage des sols marécageux et la lutte contre les inondations, nous serons en mesure d'apprécier l'ampleur de l'aménagement des eaux réalisé durant cette seconde période de la mise en valeur de la Grande Vallée.

Des résultats magnifiques n'ont d'ailleurs pas manqué de couronner tous ces efforts. Le drainage et l'irrigation ont opéré une transformation véritablement magique de cette terre désolée, marécageuse et désertique, en un vaste jardin et un immense verger. Cette culture spécialisée, intensive et rigoureusement scientifique a apporté la richesse à la Grande Vallée. Sa production annuelle, qui est de l'ordre de 600 à 800 millions de dollars, la place au premier rang des régions agricoles aux Etats-Unis. Elle a donné naissance à une industrie de mise en conserve et de préparation qui est de beaucoup la plus considérable aux Etats-Unis.

Cette économie agricole a aussi attiré les hommes. Dans cette terre qui, il y a à peine cent ans, était à peu près inhabitée, vit aujourd'hui une population de 1,500,000 personnes, établies sur plus de 60,000 fermes ou réparties entre les 83 centres urbains de la Vallée.

Troisième Période

En dépit de ces réalisations étonnantes, la Grande Vallée n'avait pas atteint les limites ultimes de son développement à la fin de la seconde période. Il restait encore de grandes possibilités à exploiter. Mais la mise en valeur de ces possibilités dépendait avant tout d'un aménagement plus complet des eaux. Aussi, bien avant 1935, sentait-on la nécessité d'un vaste plan d'ensemble visant à utiliser d'une façon rationnelle toutes les ressources hydrauliques de la Grande Vallée.

De multiples raisons militaient en faveur d'un pareil plan. Quelques-unes étaient propres à la Grande Vallée. Parmi celles-ci il y avait tout d'abord les besoins accrus en eau d'irrigation pour une agriculture en expansion. Plusieurs millions d'acres de sol fertile restaient encore improductifs ou à peu près, faute d'eau pour les irriguer. Parmi les terres irriguées, plusieurs l'étaient d'une façon inadéquate, du fait de la diminution du débit des cours d'eau en été. Cette diminution du volume des eaux de surface disponibles dans les secteurs les plus secs de la Grande Vallée, tels que le Sud de la Vallée du San Joaquin et le bassin de Tulare, obligeait les fermiers à recourir de plus en plus aux réserves d'eaux souterraines. Ce pompage accrû, à son tour, provoquait une baisse alarmante des nappes phréatiques et, en dépit du forage de puits de plus en plus profonds et coûteux, l'eau se faisait plus rare en bien des secteurs. Certaines fermes avaient même dû être abandonnées et 800,000 acres de terres étaient menacés d'un sort analogue dans un avenir plus ou mains lointain.

En second lieu, le problème des crues dévastatrices continuait à se poser avec une acuité presque aussi grande qu'auparavant, malgré les travaux de correction exécutés. On estimait ainsi que, durant les quarante dernières années, 42 crues avaient ravagé la vallée du Sacramento; 15, la vallée du San Joaquin et 13, le bassin de Tulare.

Une autre calamité contre laquelle on avait lutté avec assez peu de succès était l'invasion des eaux salées de la mer dans la région du Delta. Ces invasions étaient une conséquence de la baisse estivale du niveau du Sacramento et du San Joaquin, qui empêchait les

eaux de ces deux rivières de refouler le flot de marée venant de la Baie de San Francisco. Ces invasions d'eaux salées menaçaient de détruire les riches cultures du Delta et de polluer les eaux destinées à l'alimentation des villes du pourtour de la baie de Suisun.

En plus, des raisons d'ordre plus général appelaient la réalisation d'un tel plan. Elles sont la conséquence de l'extraordinaire expansion industrielle et urbaine de la Californie. Ce développement exige des quantités beaucoup plus considérables d'électricité pour l'industrie et la consommation domestique, de même que de nouvelles sources d'approvisionnement en eau potable pour les villes, notamment pour celles de la région métropolitaine de San Francisco, qui déjà disputent à l'irrigation les ressources actuellement disponibles.

Un plan d'une telle envergure dépassait de beaucoup les possibilités de l'initiative privée et exigeait l'intervention gouvernementale. L'Etat de Californie entra en scène en 1941 et dressa un plan connu sous le nom de State Water Plan. En 1933, commençait le vente des actions destinée à lever les fonds nécessaires à la mise en marche des travaux. Entretemps, cependant, l'Etat même, devant l'ampleur du project, se rendit compte qu'il était incapable d'assumer un tel fardeau. C'est alors qu'il entreprit des pourparlers avec le gouvernement fédéral pour faire de son plan un projet du Bureau of Reclamation. En 1935 s'effectuait le transfert et le Bureau de Réclamation prenait à son compte, en le modifiant assez peu, le State Water Plan pour en faire le Central Valley Project, qui allait marquer un tournant dans la mise en valeur de la Grande Vallée.

Le Central Valley Project envisage une utilisation rationnelle et complète de toutes les ressources en eau de la Grande Vallée. Les planificateurs avaient devant eux deux problèmes fondamentaux: un problème climatologique et un problème géographique.

Le premier consiste dans une mauvaise distribution annuelle des pluies. Comme nous le savons déjà, le malheur de la Grande Vallée est que les précipitations y tombent à la mauvaise saison, en hiver, alors que les besoins sont réduits au minimum. En revanche, l'été connaît une sécheresse presque absolue. Il en résulte que, durant cette saison où les besoins en eau sont le plus élevés, les eaux de surface et les nappes souterraines sont à leur plus bas. Comme on ne peut pas changer le régime des pluies, force est de changer le régime des cours d'eau par l'édification d'immenses barrages de retenue qui emmagasineront le surplus d'eau à l'époque du maximum de pluviosité et de fonte des neiges pour la distribuer d'une façon plus régulière au fur et à mesure des besoins.

Non seulement la pluie tombe à la mauvaise saison, mais elle tombe aussi au mauvais endroit. C'est là le deuxième grand problème qui confrontait les autorités du Bureau de Réclamation. En d'autres termes, la Grande Vallée souffre d'une mauvaise répartition géographique des précipitations. Le bassin du Sacramento concentre les deux-tiers des ressources en eaux courantes de toute la Grande Vallée, alors qu'il n'a que le tiers des besoins. En revanche, les bassins du San Joaquin et de Tulare ne possèdent que le tiers des approvisionnements en regard des deux-tiers des besoins. La déficience est particulièrement grave dans le bassin de Tulare au climat vraiment désertique. Il n'y a qu'une seule solution à ce deuxième problème: une redistribution géographique des eaux courantes par un transfert de celles-ci des régions de surplus aux régions déficientes.

C'est à la solution de ces deux problèmes fondamentaux que vise avant tout le C.V.P. Comme un tel aménagement est une oeuvre de longue haleine, on a réparti les travaux en trois phases: la phase initiale, de 1935 à 1945; une seconde phase, allant de 1945 à 1960; enfin, une troisième phase appelée celle du plan complet.

La phase initiale s'attaque à l'aménagement des deux principaux cours d'eau de la Grande Vallée, le Sacramento et le San Joaquin. (Figure 1) Cet aménagement consiste dans la régularisation du flot saisonnier par la construction d'un immense barrage de retenue sur chacun de ces cours d'eau, puis dans le transfert de l'eau du San Joaquin dans le bassin assoiffé de Tulare et du surplus de l'eau du Sacramento dans la vallée du San Joaquin, afin d'y remplacer l'eau détournée vers le bassin de Tulare.

Les deux ouvrages fondamentaux de cette phase sont le barrage de retenue de Shasta sur le Sacramento et celui de Friant sur le San Joaquin.

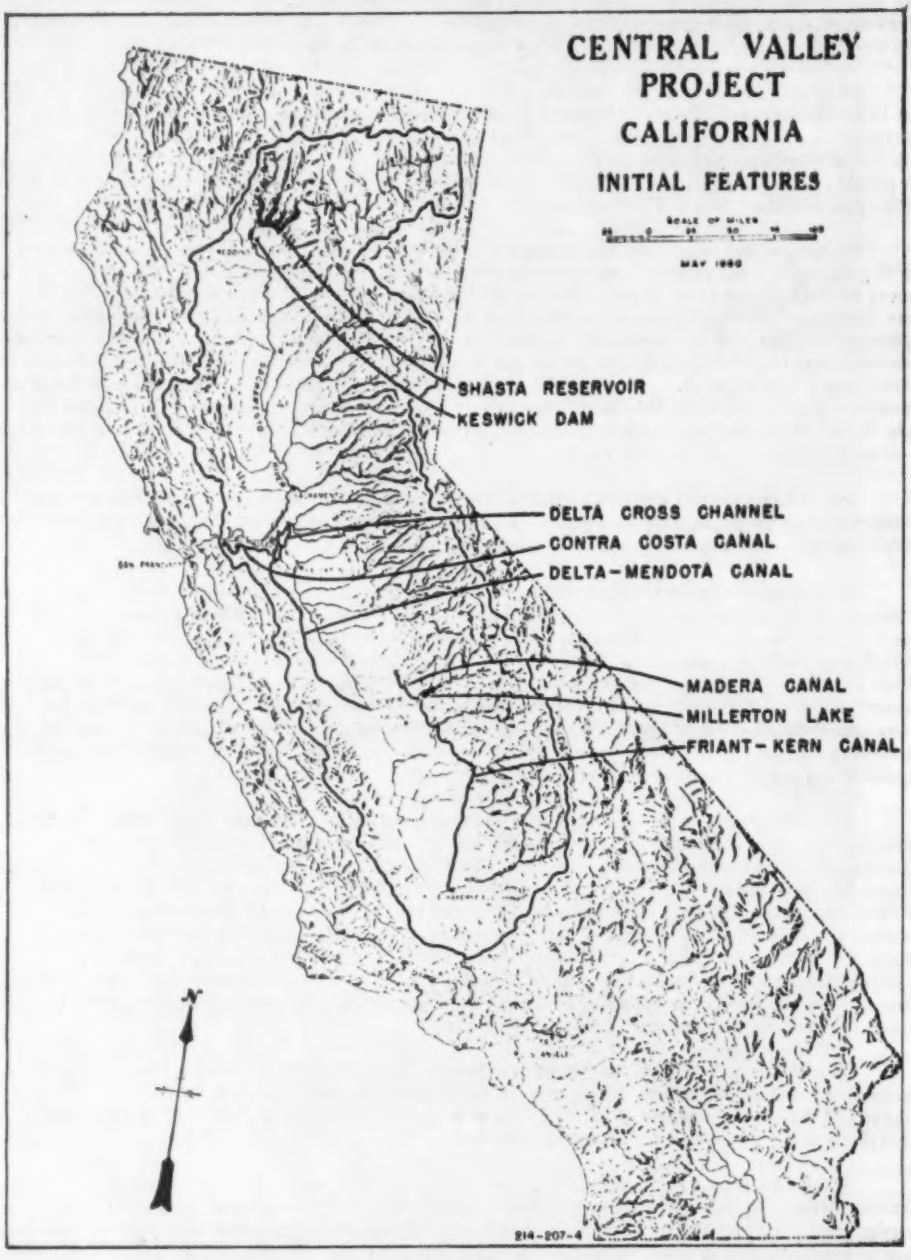

Figure 1.

Le barrage de Shasta est la clef de voûte de tout le plan. Construit un peu à l'amont de Redding sur le Sacramento, ce barrage, le second du monde pas sa hauteur et sa longueur, refoule les eaux du Sacramento, du McCloud et du Pit pour former un vaste lac artificiel,

réservoir capable d'emmagasiner 4,500,000 acres-pieds d'eau. Les eaux ainsi emmagasinées serviront d'abord à satisfaire les besoins en eau d'irrigation de la vallée du Sacramento. En même temps ce storage permettra de régulariser le débit du fleuve dans le but de prévenir les inondations et de faciliter la navigation. De plus, le surplus d'eau ainsi emmagasiné sera transféré dans la vallée du San Joaquin.

L'autre ouvrage principal est le barrage de retenue de Friant, construit sur le San Joaquin. Ce barrage refoule les eaux du San Joaquin et forme le lac artificiel Millerton, d'une capacité de 500,000 acres-pieds. Il a pour fonction principale d'emmagasiner les eaux de crue du San Joaquin et de les détourner vers le bassin de Tulare et le comté de Madera pour en irriguer les riches cultures fruitières. En même temps il servira à régulariser le débit du San Joaquin et à prévenir les inondations dans sa plaine alluviale.

A ces ouvrages de base s'adjoignent de nombreux travaux connexes tels que centrales électriques, lignes de transport de force, canaux pour le transport de l'eau et usines de pompage.

Tout d'abord, au barrage de Shasta, on a édifié une grande centrale hydro-électrique, d'une capacité normale de 375,000 kW et d'une capacité en pointe de 450,000 kW. Cette centrale a d'abord pour but de produire l'énergie nécessaire pour actionner les moteurs de l'usine de pompage de Tracy. Le surplus sera disponible pour la vente aux industries, aux municipalités et aux fermes et les revenus provenant de la vente de ce courant serviront à amortir la plus grande partie des dépenses de construction et les frais d'administration du barrage et des autres ouvrages nécessaires à l'irrigation, et, ainsi, à diminuer le coût de l'eau d'irrigation pour le fermier.

Un barrage secondaire, celui de Keswick, édifié un peu à l'aval de Shasta, servira à régulariser, pour fins d'irrigation et autres, le débit des eaux restituées par la centrale de Shasta. A ce barrage on a annexé une centrale subsidiaire d'une capacité de 75,000 kW.

Le transport proprement dit de l'eau de surplus du réservoir de Shasta aux terres de la vallée du San Joaquin comporte les ouvrages suivants: le Delta Cross Channel, l'usine de pompage de Tracy et le canal Delta-Mendota.

Le Delta Cross Channel prend les eaux de surplus du Sacramento et les transporte à travers le Delta vers l'usine de pompage de Tracy. Comme fonction secondaire, ce courant d'eau douce servira à refouler les eaux salées de la mer afin de les empêcher d'envahir les régions basses du Delta.

L'usine de pompage de Tracy tire les eaux du Sacramento arrivant par le Delta Cross Channel, les élève de 200 pieds pour les déverser dans le canal Delta-Mendota. Cette usine a une capacité de 4,600 pieds cubes d'eau à la seconde. Le canal Delta-Mendota transporte cette eau, le long de la rive gauche du San Joaquin, dans le Mendota Pool d'où des canaux de distribution la porteront aux terres autrefois irriguées par les eaux du San Joaquin, maintenant déviées à Friant. Ce canal a un débit de 4,600 pieds-seconde.

De plus, dans la région du Delta, on a creusé le canal Contra Costa qui, équipé de 4 usines de pompage, tire 350 pieds cubes d'eau à la seconde du Delta pour l'irrigation des fermes du comté de Contra Costa et pour l'approvisionnement en eau des villes et industries de la rive sud de la baie de Suisun. Ce canal a 48 milles de long. Enfin, on a installé une centrale thermique subsidiaire, le Delta Steam Plant, d'une capacité de 330,000 kW., destinée à faire face à toute demande d'urgence.

Du barrage de Friant partent deux grands canaux de transport de l'eau. Le plus important est celui de Friant-Kern, d'une longueur de 153 milles et d'un débit maximum de 5,000 pieds-seconde, qui servira à l'irrigation des comtés de Fresno, Tulare et Kern. Le second, le canal Madera, de 37 milles de long et d'un débit maximum de 1,000 pieds-seconde, va vers le Nord-Ouest porter les eaux d'irrigation aux terres du comté de Madera.

Voilà, brièvement décrits, les principaux ouvrages de la phase initiale du C.V.P. Ces travaux gigantesques sont à peu près tous terminés. Ils permettront l'irrigation adéquate des immenses vergers de figues, pêches et raisins qui font la richesse de l'extrême Sud de la

Grande Vallée. L'énergie électrique développée, en plus de servir à défrayer le coût de construction et les frais d'entretien des travaux d'irrigation, mettra à la disposition de l'industrie et des villes de nouvelles sources énergétiques qui favoriseront l'expansion industrielle

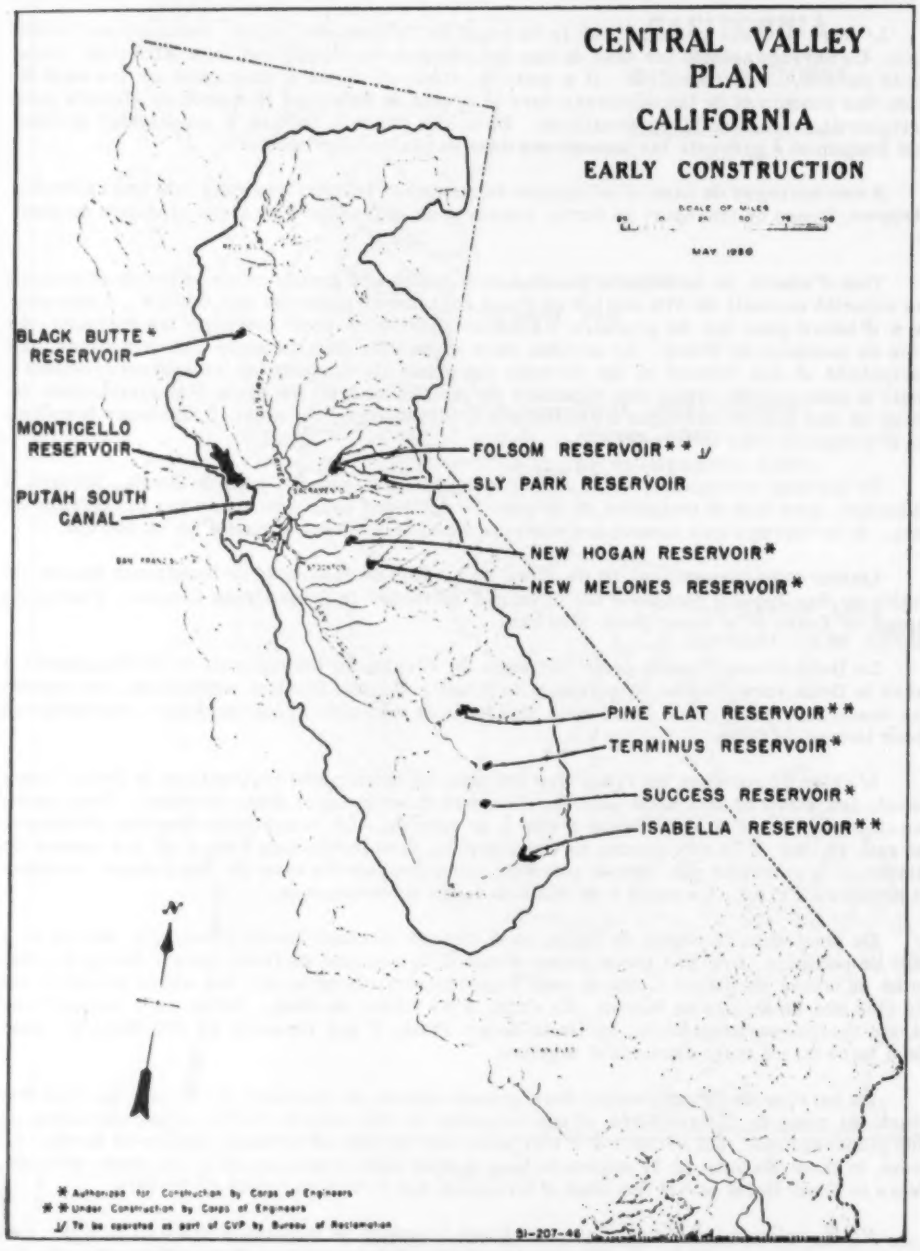

Figure 2.

et urbaine des villes de la Grande Vallée et de la région de San Francisco. La régularisation du débit du Sacramento et du San Joaquin permettra une meilleure prévention des inondations et facilitera la navigation sur ces deux cours d'eau. Enfin, ces travaux serviront à empêcher

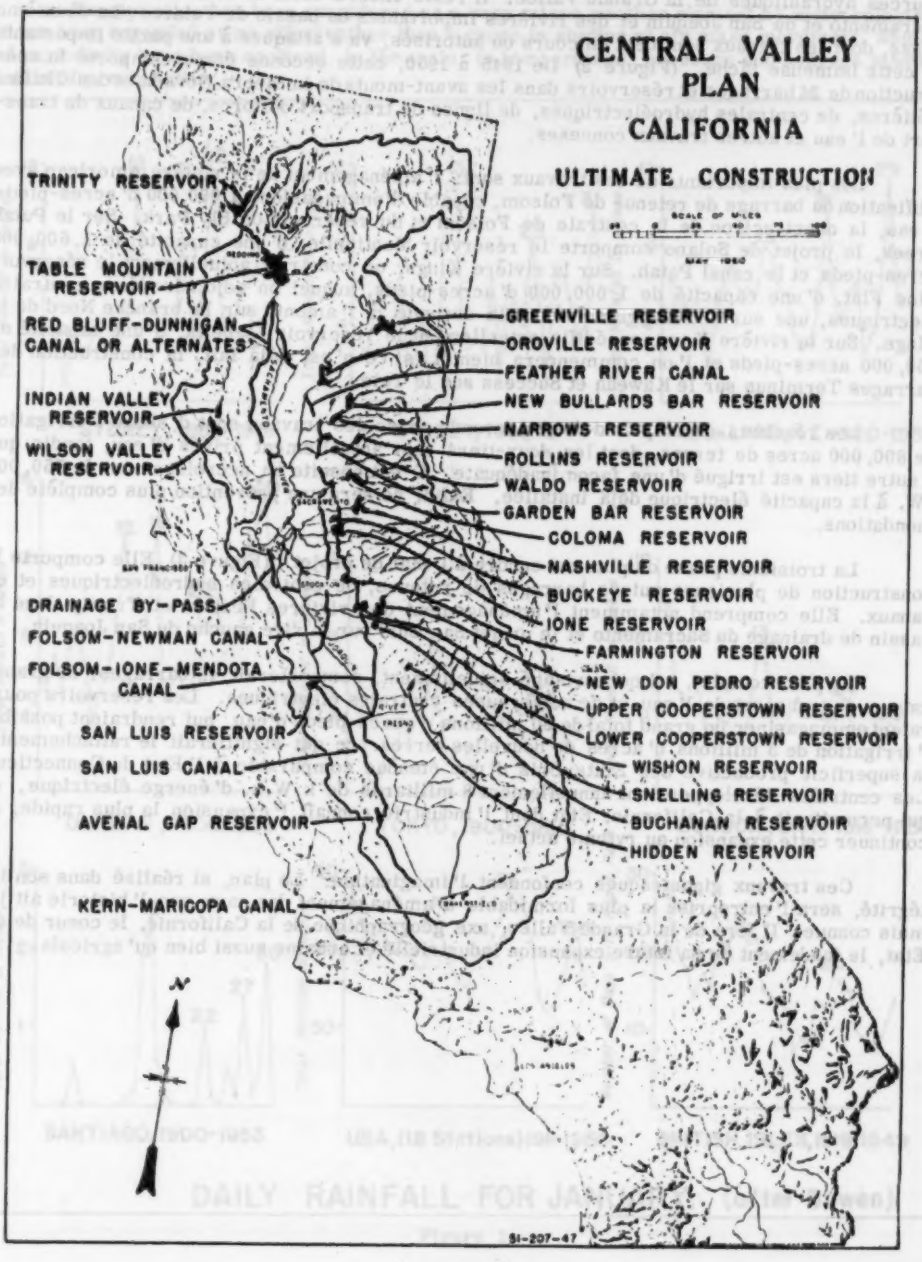

Figure 3.

l' invasion des eaux salées dans le Delta. Tels sont les principaux bénéfices que l' on espère retirer de cette première phase du plan.

Nous sommes, cependant, encore loin de l' aménagement complet de toutes les ressources hydrauliques de la Grande Vallée. Il reste encore celui de tous les tributaires du Sacramento et du San Joaquin et des rivières importantes du bassin de Tulare. La deuxième phase, dont les travaux sont déjà en cours ou autorisés, va s'attaquer à une partie importante de cette immense tâche. (Figure 2) De 1945 à 1960, cette seconde étape comporte la construction de 24 barrages et réservoirs dans les avant-monts de la Sierra Nevada et des Chaînes Côtières, de centrales hydroélectriques, de lignes de transport de force, de canaux de transport de l' eau et autres travaux connexes.

Les plus importants de ces travaux sont: l' aménagement de la rivière American avec édification du barrage de retenue de Folsom, capable d'emmagasiner 1,000,000 d' acres-pieds d' eau, la construction de la centrale de Folsom et du réservoir de Sly Park. Sur le Putah Creek, le projet de Solano comporte le réservoir Monticello, d' une capacité de 1,600,000 acres-pieds et le canal Patah. Sur la rivière Kings, on construit actuellement le réservoir Pine Flat, d' une capacité de 1,000,000 d' acres-pieds, auquel on adjoindra deux centrales électriques, une sur le barrage même et la seconde, à l' amont, sur la branche Nord de la Kings. Sur la rivière Kern, en édifie actuellement le réservoir Isabella, d' une capacité de 550,000 acres-pieds et l' on commencera bientôt, si ce n' est déjà fait, la construction des barrages Terminus sur le Kaweah et Success sur le Tule.

Les résultats escomptés de cette seconde phase des travaux sont d' abord l' irrigation de 800,000 acres de terres, dont les deux-tiers sont actuellement privés d' eau, tandis que l' autre tiers est irrigué d' une façon inadéquate. C' est ensuite un accroissement de 550,000 kW. à la capacité électrique déjà installée. Enfin, ce sera une prévention plus complète des inondations.

La troisième phase du plan est encore à l' état de projet. (Figure 3) Elle comporte la construction de plusieurs autres barrages de retenue, de centrales hydroélectriques et de canaux. Elle comprend notamment l' aménagement des rivières Feather et Trinity dans le bassin de drainage du Sacramento et le projet San Luis sur la rive gauche du San Joaquin.

Le plan complet, tel qu' envisagé actuellement, comporterait 48 barrages, 20 grands canaux de transport de l' eau et de nombreuses centrales électriques. Les réservoirs pourraient emmagasiner un grand total de 30 millions d'acres-pieds d'eau, qui rendraient possible l' irrigation de 3 millions d' acres de nouvelles terres: ce qui signifierait le rattachement à la superficie productive des Etats-Unis d' une étendue comparable à l' Etat du Connecticut. Les centrales développeraient annuellement 8 milliards de k.W.h. d' énerge électrique, ce qui permettrait à la Californie, Etat dont l' industrie connaît l' expansion la plus rapide, de continuer cette expansion au rythme actuel.

Ces travaux gigantesques confondent l' imagination. Le plan, si réalisé dans son intégrité, sera l' entreprise la plus formidable d' aménagement des eaux que l' historie ait jamais connue. Il fera de la Grande Vallée, axe géographique de la Californie, le coeur de cet Etat, le fondement de sa future expansion industrielle et urbaine aussi bien qu' agricole.

NOTE ON THE ANNUAL PERIODICITY OF DAILY RAINFALL IN CANADA

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Precipitation has been considered as a very minor weather element by meteorologists. It has been regarded as an effect rather than a cause in studies of air mass movement. Studies of periodicity have been confined, in the main, to temperature, pressure and average monthly totals of precipitation.

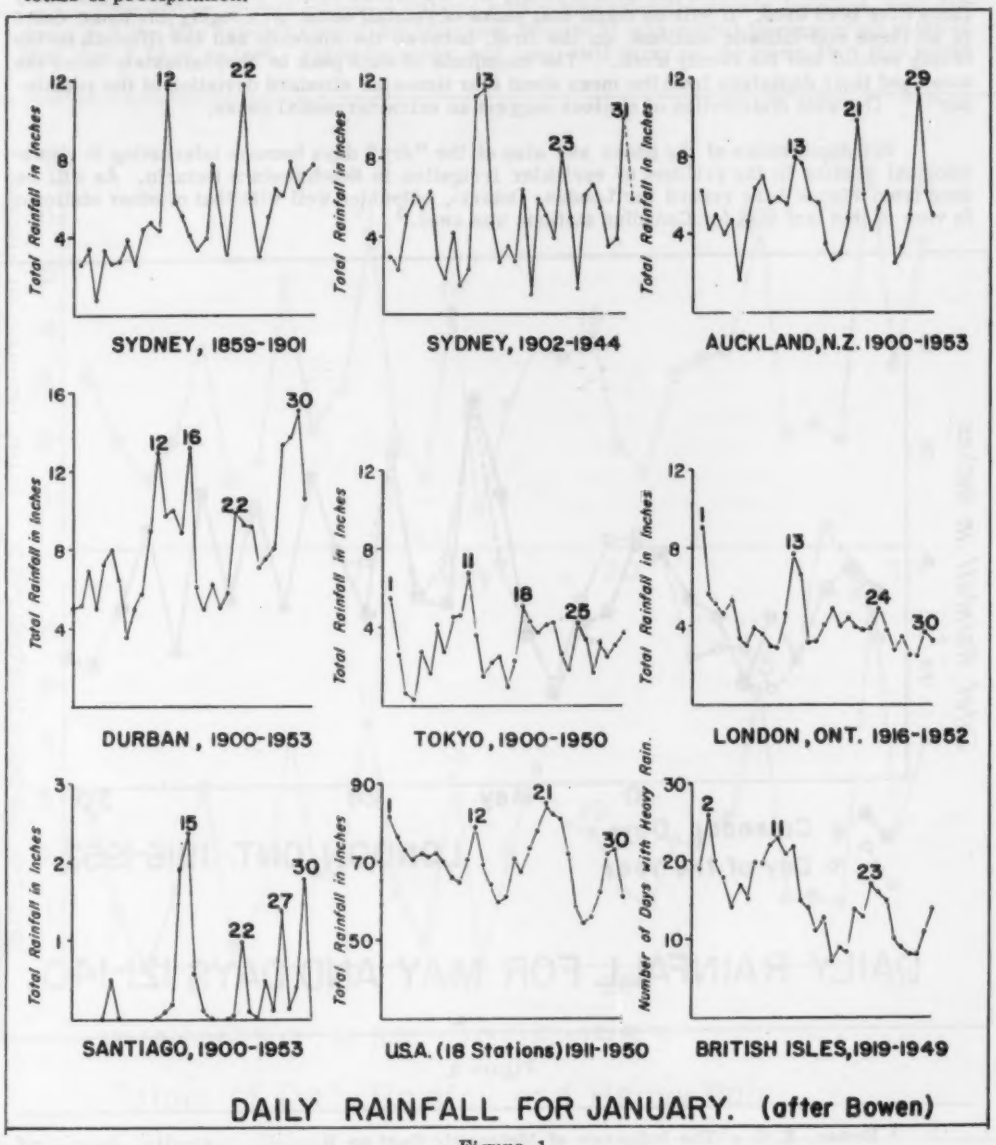

Figure 1.

However, in connection with research into methods of inducing rainfall by cloud seeding, E.G. Bowen of Sydney, Australia, examined the record of daily precipitation and found that "it is apparent that in some localities there is a marked tendency for heavy falls of rain to occur on certain days rather than on others and for this pattern to be repeated year after year".[1]

Figure 1 shows the precipitation records for six individual stations, Sydney, Auckland, Durban, Santiago, Tokyo and London, Ontario, for January, and two countries, the U.S.A., where the record 18 stations has been totalled, and the British Isles, where only the very heavy rains have been used. It will be noted that peaks of rainfall occur on roughly the same dates in all these mid-latitude stations: on the first, between the eleventh and the fifteenth on the twenty second and the twenty ninth. "The magnitude of each peak is approximately twice the mean and their departure from the mean about four times the standard deviation of the remainder".[2] The wide distribution of stations suggest an extra-terrestial cause.

The significance of the peaks and also of the "dry" days become interesting in climatological studies in the problem of sprinkler irrigation in Southwestern Ontario. As will be seen from Figure 1 the record for London, Ontario, coincides well with that of other stations. In view of this fact data for Canadian stations was used.[3]

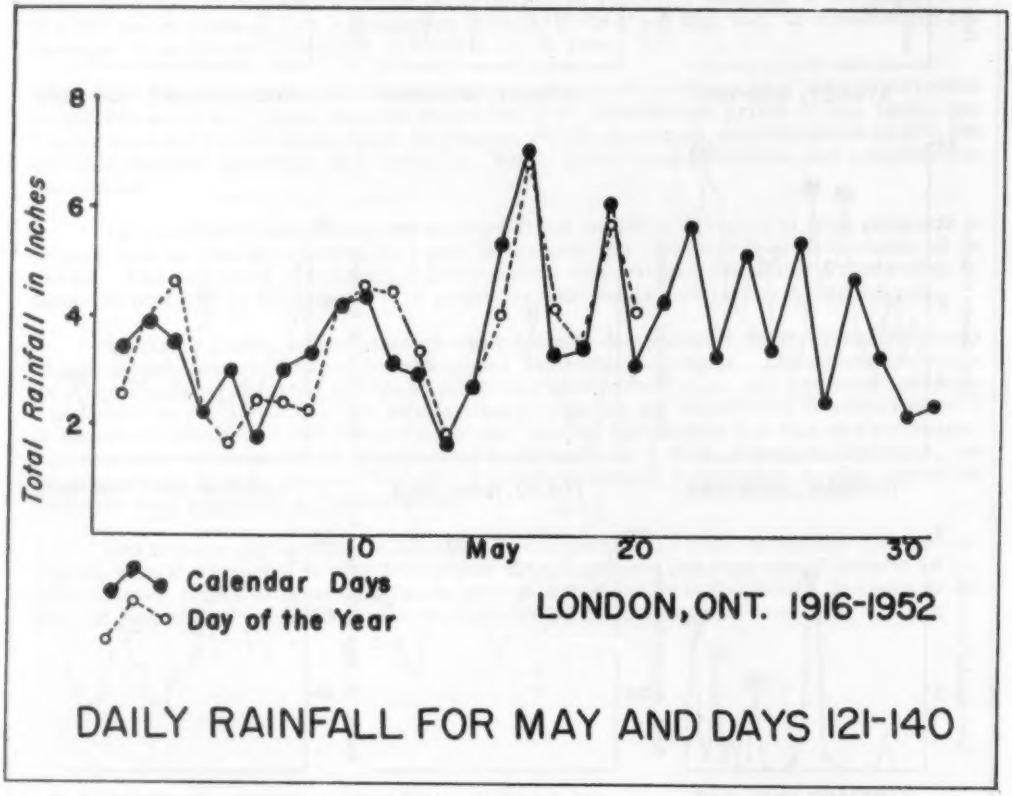

Figure 2.

[1] Bowen, E.G.: The Influence of Meteoritic Dust on Rainfall; Australian Journal of Physics, 6, 1953, pp. 490-497.

[2] Ibid.

[3] Canada, Dept. of Transport, Meteorological Division: Monthly Record, 1916-1951.

The method is very simple but laborious. It consists of adding all the rain, or the water equivalent of snow, which has fallen on any particular calendar day for the period of record. The question arose what about leap year and its additional day. Figure 2 shows the rainfall record for May for London, Ontario, for the period 1916-51 and as was expected peak rainfalls and "dry" days occurred. The figures were then adjusted for the day of the year not the calendar day. Very little difference was noted as shown by the broken line. In addition it was thought that leap year is simply a method of adjusting the calendar to get it back in phase with the earth's orbit.

Compilation of data of many stations with minor rainfall amounts becomes most arduous and the May rainfall record for Winnipeg (Figure 3) was edited to remove all rains of less than 0.25 of an inch. Since the peaks and lows still occur on the same days this would

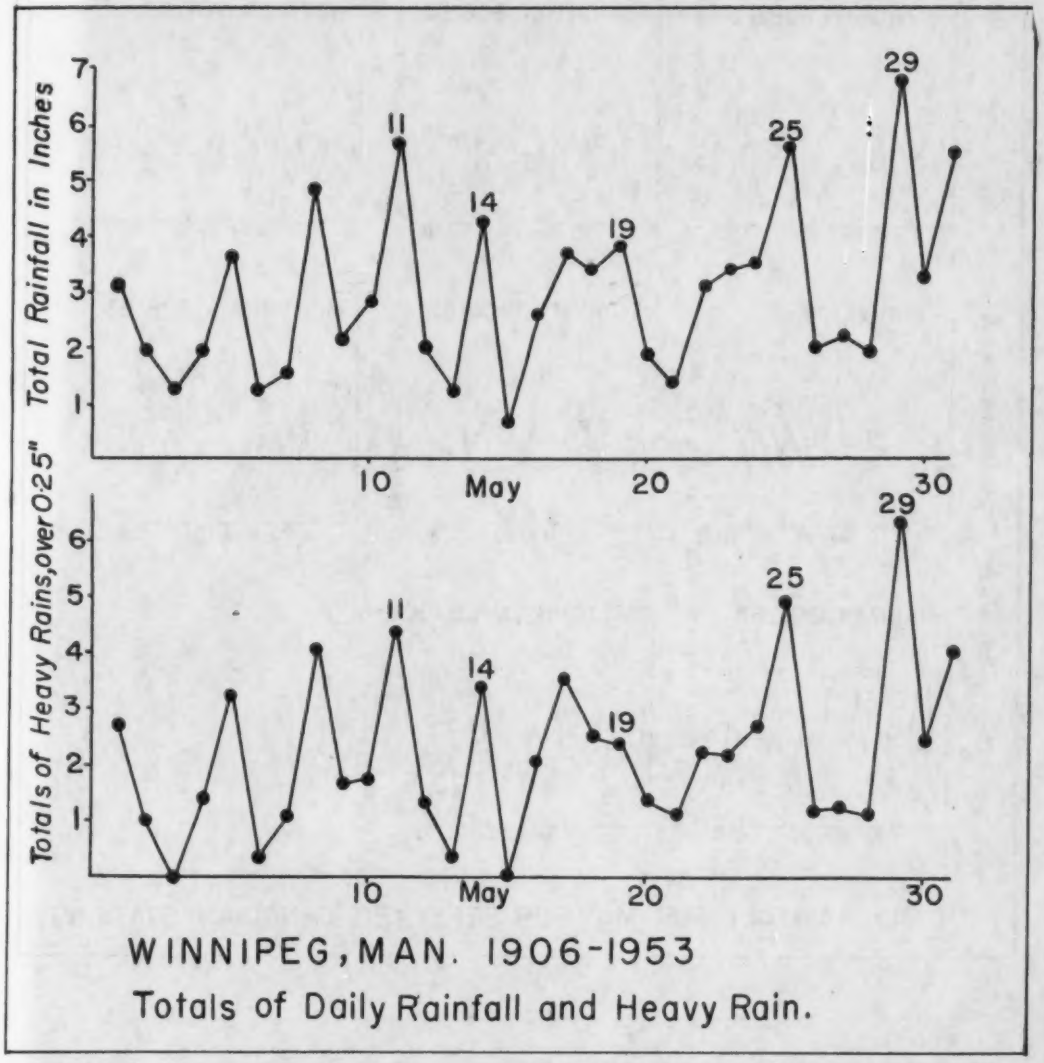

Figure 3.

not appear to detract from the accuracy of the method. Bowen has suggested[1] using only those days with over one inch of rainfall but that seems to leave too much margin for error.

The results of the work so far are presented in Figure 4. It must be noted that the period of record varies for the different stations. In some stations the record is incomplete, in others the recording station has been moved. Some use total rain, some only heavy rain. However, the rainy days for May are still quite visible. The second, the tenth, the seventeenth,

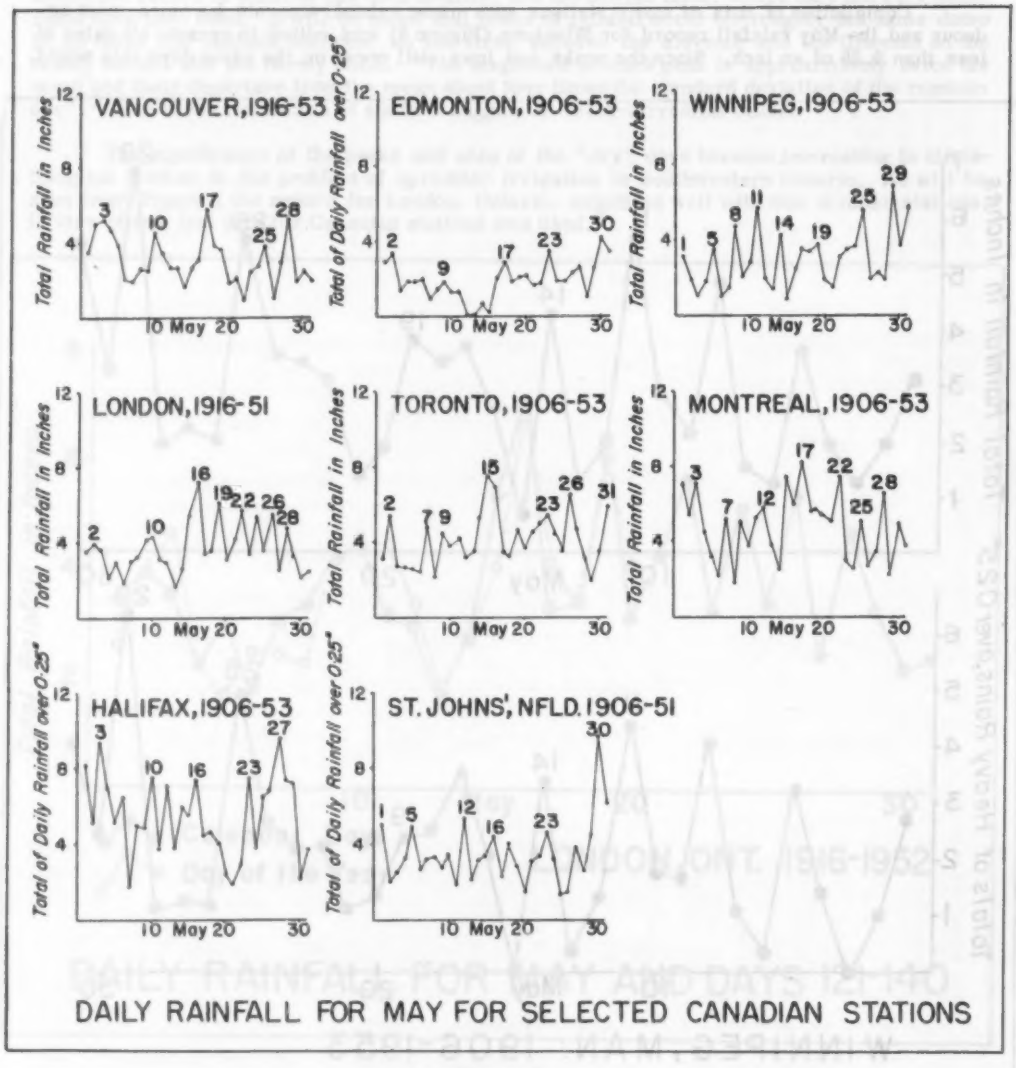

Figure 4.

[1] Personal communication to the author, May 1954.

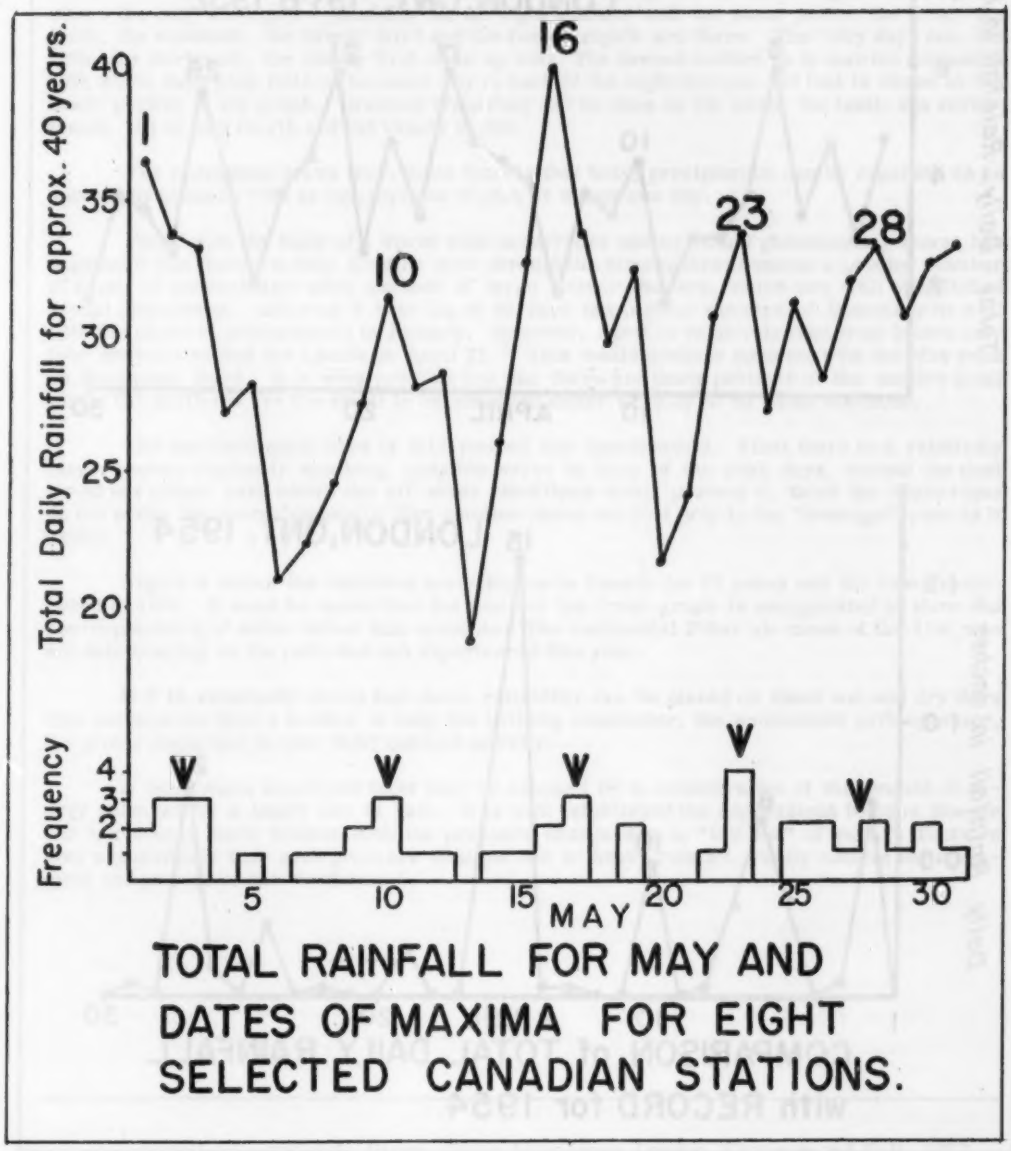
Total Daily Rainfall for approx. 40 years.
40
35
30
25
20
1
10
16
23
28
Frequency
4
3
2
1
5
10
15
20
25
30
MAY
TOTAL RAINFALL FOR MAY AND DATES OF MAXIMA FOR EIGHT SELECTED CANADIAN STATIONS.

Figure 5.

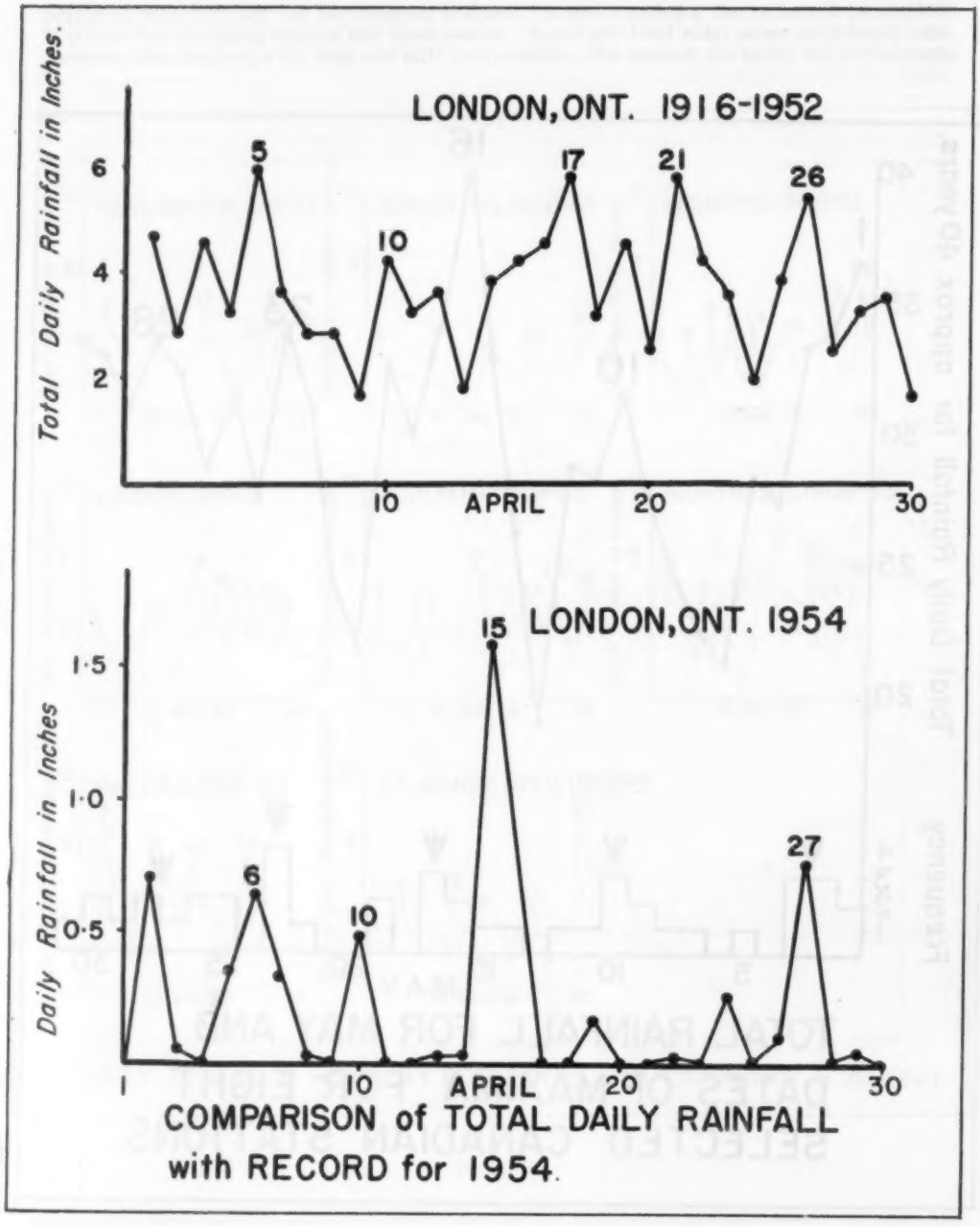
LONDON, ONT. 1916-1952
Total Daily Rainfall in Inches.
6
4
2
5
10
17
21
26
10
APRIL
20
30
LONDON, ONT. 1954
Daily Rainfall in Inches
1·5
1·0
0·5
15
6
10
27
1
10
APRIL
20
30
COMPARISON of TOTAL DAILY RAINFALL
with RECORD for 1954.

Figure 6.

the twenty third and the twenty eighth. The "dry" days the fifth, the fifteenth and the twenty first are also present. The standard deviation of peaks and lows for London for May is 1.81 inches while for the rest of the days it is 0.53 of an inch.

The graphs reveal a certain amount of discrepancy from station to station, but it is not a discrepancy which varies with longitude. It does not seem to be an eastward movement of rain.

There are two ways of dealing with this data and they are shown on Figure 5. The graph shows the total unweighted rainfalls for all eight stations and the same peaks, the first, the tenth, the sixteenth, the twenty third and the twenty eighth are there. The "dry days too, the fifth, the thirteenth, the twenty first show up well. The second method is to note the frequency with which each peak falls on the same day in each of the eight stations and that is shown in the lower portion of the graph. Greatest frequency can be seen on the third, the tenth, the seventeenth, the twenty fourth and the twenty eighth.

The conclusion drawn from these facts is that heavy precipitation can be regarded as an annual phenomenon with an imprecision of plus or minus one day.

Faced with the facts of a world wide occurrence and an annual phenomenon, Bowen has suggested that meteoric dust, floating down through the atmosphere presents a greater number of nuclei of condensation after periods of large meteor showers, which are well established annual phenomena. Allowing a time lag of 29 days the meteor showers of December fit well with the peaks of precipitation in January. However, April is relatively free from known meteor showers except the Lyrids on April 21.[1] This would perhaps coincide with the May peak on the twenty third. It is very possible too that there are dusty portions of the earth's orbit where the particles are too small to be observed either visually or by radar methods.

The meteorological uses of this method are questionable. First there is a relatively large, meteorologically speaking, possible error in time of the peak days, second the dust would not create rain where the air mass conditions would prevent it, third the heavy rains do not occur any more frequently than smaller rains, so that only in the "average" year is it useful.

Figure 6 shows the recorded precipitation in London for 37 years and the rain experienced in 1954. It must be noted that the scale of the lower graph is exaggerated to show the correspondence of dates rather than amounts. The continental Polar air mass of the 21st was not rain bearing so the peak was not experienced this year.

If it is eventually shown that more reliability can be placed on these wet and dry days then perhaps we have a method to help the building contractor, the amusement park operator, the picnic organizer to plan their outdoor activity.

A much more important facet may be exposed by a consideration of the amount of energy released by a heavy fall of rain. It is well established the depressions become deeper and hurricanes more intense with the pressure change due to "fall out" of rain.[2] There is then a possibility that such pressure changes due to heavy rainfall, really control the movement and pattern of our weather.

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[1] Lovell, B., and J.A. Clegg: Radio Astronomy; London, Chapman and Hall, 1952.

[2] Haurwitz, B.: Dynamic Meteorology; New York, McGraw-Hill, 1941, p. 315.

THE RE-EXPLORATION OF CANADA[1]

F. Kenneth Hare

McGill University

Tonight I want to talk about the role we as geographers ought to play in national development. We are living, as Julian Huxley puts it, in a revolution, a period when the whole pattern of Canadian life is being altered by an unprecedented industrial expansion. With our gross national product increasing 3% per annum in real values, with new and almost unsuspected sources of material wealth revealing themselves almost annually, we stand where the United States stood three-quarters of a century ago, at the threshold of full economic realization. Even if the American economy should falter, the interruption in our ascent should prove merely a stumble. Since I arrived in this country eight years ago the scene has changed prodigiously; Alberta oil has appeared; Labrador iron has been proven and is about to enter world markets; the forest industries have undergone an astonishing expansion, the city of Montreal, my home, has 25% rebuilt itself in a forest of new (if ugly) homes.

Now I suggest -- and here is the crux of my argument -- that this development is founded on the re-exploration of Canada, on the re-examination of our national resources. Hitherto we have barely passed the phase of preliminary reconnaissance. Our 8-mile maps symbolize the situation. They contain a fairly accurate record of our rivers, lakes and coastlines. But beyond the limits of the southern population districts, they remained essentially blank until recent times. Our knowledge of the geology, forest resources and even of power potential has remained sketchy, and in many northern areas can barely be said to exist. This is in no sense a criticism of our governmental survey organizations, nor of the prospectors to whom we owe so much of our present mineral development. The blankness of our maps reflects incredible distances, unbelievable areas. Labrador-Ungava itself exceeds in area France, Germany, Spain and Britain combined. It is amazing, when one remembers the immensity of the task that the surveyors have achieved as much as they have.

But the trouble with our scientific effort until recently has been the minuscle nature of its methods. We have imported from Europe and more densely settled U.S.A. a conception of scientific survey suitable for small, well-settled areas. Our geologists, for example, have until recently had no efficient scale of action between the safari-like reconnaissance of Low, Tyrrell or Dawson and the detailed field-mapping on the mile-to-the-inch scale. The result is that the geological map of Canada is still, for the most part, a wash of indifferentiated pink -- for Archaean gneiss! It is much the same with our forest and soil maps. Where they exist, they are excellent; where they do not, we must guess. It is surely imperative that we should use other methods, somewhere between overland reconnaissance and detailed field survey.

In the post-war period, these new methods have begun to appear. The geologist and the prospector have been aided by the airborne magnetometer, and the petroleum geologist by the widespread application of seismic methods. It illustrates my thesis very well to point out that the new iron-ore body near Belleville, in thickly settled country, was discovered by these new geophysical methods in a district that had already been well hunted by traditional field methods. The Geological Survey of Canada, highly conscious of the need to cover the ground faster, has begun to use the helicopter, a device that might almost have been designed for the field geologist. In the summer of 1952, for example, one party with two helicopters surveyed 57,000 square miles of Keewatin in the single season. By such means the pace of exploration is being accelerated apace, and the geological map of the country is slowly getting more interesting.

But I suggest that the task of re-exploration is still not really begun. Our methods are still too slow, too clumsy. National inventory cannot wait much longer. It is my conviction

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[1] Address delivered at the January 1954 meeting of the Southern Ontario Division of the Canadian Association of Geographers in Hamilton, Ontario.

that we geographers have a vital role to play. Opportunity beckons to us. But before I enlarge on this theme I must digress a little.

Canadian geographers are still struggling, not merely for greater professional and academic respectability, but for a clear-cut mission in the national life. We have come a long way in the 20 years since Griffith Taylor came to Toronto. We are solidly established in the universities, and have got a foothold, at least, in the federal government. Even the provinces, though they cloak us in the garments of economists, sociologists and even geologists, make use of our services and occasionally, as in Ontario, do something about our suggestions. But few of us feel happy about the present status. We have powerful enemies near the throne in Ottawa, who see no use for governmental geography. I have heard a senior civil servant, whose influence on policy is considerable, say that the geographer does badly what a team of geologists, climatologists, ethnologists, engineers, soil scientists and foresters does well. Fortunately our interests in Ottawa are in good hands -- Messrs. Bowen and Watson make a formidable defence team -- and are by no means at a loss as promoters of the science ! Even so, only an optimist would say that their task is an easy one.

My own conviction is that deeds, not words, are needed. Canadian geography will create an acknowledged role for itself by its achievements in nationally significant research, above all in research whose integrity and absolute value is obvious to our professional neighbours notably the geologists, soil scientists, botanists and economists. We shall get nowhere by making jurisdictional claims to a given field of research. We may claim, for example, that land use survey is a fundamental method of the geographer, who really "owns" it academically; but our governments will go on hiring soil men, agricultural economists and engineers to do the job until we can show, by concrete example, that we do it better. We may also feel, as I do, that climatology is our business. I cannot see, however, the meteorologists conceding this in their own hearts until we can show them that our methods are distinct, our results of wide significance and our approach at least as sophisticated as theirs. Finally, geomorphology, a field neglected but not abandoned by the geologists, will be ours only inasmuch as we can unravel the landscape tangle faster than they.

This brings me back to the main thread of my remarks. Let me rephrase the questions we are asking. How can we geographers (1) get ourselves a field of research that will receive widespread acceptance, (2) contribute to the development of the nation? I shall try to answer this under heads.

First, let us think of scale. As I said, what Canada needs today is research on a scale bigger than that of low-style reconnaissance, but smaller than the eleborate local research as typical of over-populated Britain or Massachusetts. I believe that we should deliberately set out on a campaign of re-exploration of the country's surface. It follows that local studies, intellectually valid though they may be, are less valuable than regional or even nation wide studies. We have, I suggest, to think on the scale of Putnam's well-known paper on the pedogeography of Canada, or my colleague Bird's studies on the physiography of Keewatin. We can operate on this scale, and still preserve adequate standards of precision (as these workers have). Even the research thesis should, in my view, cover as much ground as possible. Too many graduate students waste their genius on tiny plots of ground, creating little molehills of learning on the vast fields of Canada.

Second, let us consider the relevant fields. What does the country need? Above all, it needs an inventory of its resources. I suggest, therefore, that we ought to direct some attention -- though not an unhealthy amount -- to surveys likely to extend our known resources, especially in land. In the same field, I think we have neglected the complementary study of land abandonment, of the reduction of the rural population and the geographical consequences of the drift towards the city. The field of physical planning, one in which the geographers of this province have done notable things, belongs here; it promises much, but I feel that we ought to keep our eye on the distant horizon, rather than on the city block. We are not sociologists, and we are not engineers, and we need enough land to start with for our methods to tell.

Thirdly, let me ask the question -- where? Obviously, in one sense, everywhere; no part of the country has yet been research-saturated, or bled academically white, so to speak. But let me put in a plea for the distanct places, of which we know so little. Geography should

start at home, but not stay there. Our primary duty is to explore the unexplored, to fill in the blank maps of the remote areas. Labrador, for example, or Northern Ontario -- or even the Prairies, in large part. The country needs such re-exploration. It is not a matter for academic or methodological argument, but one of national priorities. We need more work like Bird's in Keewatin, Mackay's in Cornwallis, Baird's in Baffin and Dean's on the Kenogami. There are not enough of us to do this and still devote the services of a research team on a single county in southern Quebec.

Fourthly, and perhaps I ought to say fifth, sixth, and so on to sixty-four! -- let us ask -- how? One might say, how, in God's name? For the difficulties are studpendous. This Association has many members, not all of whom are active in research. Suppose we take an optimistic figure and assume that this year there are 100 workers in geographical research in Canada. That still gives one of use 35,000 square miles to work on! In the United Kingdom and Southern Ireland there are some 500 researchers, who have an average of 300 square miles each! Obviously we need new methods, and cannot think in British or even American terms. We shall some day write our biographies under the title, "Life in a Big Country".

I am in no position to give a complete answer to this fourth question. But I can make at least one suggestion -- aerial photographic interpretation.

It is no accident that in this field Canada leads the world. With our immense distances, the airborne camera is an indispensable tool, not only for specialist jobs like forest inventory, but for general topographic survey. Traditional geodetic and trigonometrical surveying will get us nowhere except in densely settled areas for which precise contouring is needed. In any case, the decision has been made to use the aerial camera for the greater part of our national topographic survey, and no other country has an organization comparable with Canada's.

The original flying, as most of you know, is largely done by the photo squadrons of the R.C.A.F. Under the interested control of Air Marshal Curtis, these squadrons -- few in number and in aircraft -- photographed no less than 950,000 square miles in a single summer by the trimetrogon process. We have still far to go with the vertical programme, but the trimet coverage is now virtually complete, and our 8-mile maps are acquiring an unaccustomed accuracy. Look, for example, at the present Lake Bienville sheet, and then compare it with the previous edition! Not only, however, do we possess an Air Force equipped for such work, we also have a private industry capable of like things, and actively engaged in the national programme under contract to the Federal Government. The Photographic Survey Corporation, Aero Surveys, Spartan Airways are but a few of these.

The research value of this programme is mightily enhanced by the federal policy of concentration of prints in a central collection, to which anyone can go. The National Air Photographic Library is a unique institution. Its 3,500,000 prints, carefully filed and indexed, are awaiting attention. Their usefulness is enhanced by the ease of access and the enthusiastic attitude of the men in charge, who want to see them used. There is one fly in the ointment; at the moment there is no research space at the Library. It is to be hoped that this defect will be remedied very soon.

The interpretation of aerial photographs is a skilled technique for which the geographer, with his broad interest in the morphology of landscape, ought to be uniquely qualified. We can safely leave the photogrammetric survey techniques to the professional surveyor, though we ought to know how he goes about his job; we have no more concern with photogrammetry than with trigonometrical survey. We are interested in the topographic map as a base for operations, and not as a finished job in itself. But the photograph can be used as a first-class geographical tool if we know how to use it. If we have the right interpretation keys -- I shall return to this -- we can use it to show us a large part of both the physical and cultural landscapes. Precisely what does it show?

On the physical side, the photographs enable one to infer bedrock type (crudely), surface deposits, broad relief, drainage and many directional features, such as dunes, glacial landforms, bedrock structures and old shorelines. They tell us many significant things, in fact, that field-work and topographic mapping both miss. Vegetation is also magnificently displayed. It is physiognomy, of course, that one sees, not floristic composition. But phy-

siognomy is vegetation's most significant geographical characteristic. The forest can be assessed economically too; forest inventory today uses the photograph as its main tool.

On the cultural side, the photographs can be used to make a land-use map as detailed as one wishes. The World Land Use Survey classification can be used without difficulty on mosaics on scales down to 1 in 500,000. Rural settlement can be plotted, and so can patterns of land abandonment and spoliation. The urban and industrial landscapes are open books -- though one cannot distinguish between a factory making nylons and one making shirts. Nevertheless, urban morphology from the air is an open book. The military intelligence organizations contain skilled interpreters who can do from the aerials almost anything that the urban geographer needs in the way of a land use map. A fascinating aspect of the cultural aspect of interpretation arises out of the survival in the aerials of ghost landscapes of the past. Though they have largely vanished from the landscape visible to the walker or trigonometrical surveyor, the Bronze and Iron Age arable fields, trackways and farmsteads still survive, miraculously, on many aerial photographs. So also do the mediaeval strip fields. Vanished railways, old farms, deserted villages are unmistakable. The English landscape has been likened to a palimpsest -- a mediaeval parchment used over and over again on the erased ruins of the last missive. An aerial photograph of Salisbury Plain shows how true this simile can be.

Valuable as the photographs are, they are as yet used only as adjuncts to most survey work, and have barely been touched as the basis of extensive regional surveys. As a profession, we are barely conscious of their possibilities. Only a handful of American geographers -- such as Powers at Northwestern and Stone at Wisconsin -- seem to have taken them seriously. Others, notably the foresters, have been wiser. But I want to underline my conviction that the geographer, and no narrow specialist, should be the key man in this new field. Why?-- because of a principle that I regard as cardinal in a big country -- the principle of multiple survey.

In brief, this means nothing more than that we cannot afford to carry out our national inventories singly, piece by piece, specialism by specialism. In a country as big as ours, our regional surveys must be as comprehensive as possible. We cannot afford to look at the photographs separately for each component: we must get the whole landscape, or as much as the photos will yield, at one inspection. We want to get at least the main physiographic elements, the drainage, the natural vegetation and all the cultural forms. The federal government is full of specialists who can get one thing out of the photos, forest inventory, for example, or the glacial geology -- but such specialists never complete the regional map, and a complete regional map we desperately need. Only we geographers have the tools, the ideas and the will to do this, and as yet we are not doing it.

Multiple survey, then, that is our job. We have first to establish the interpretation keys, and then we must map. A skilled interpreter can cover an 8-mile sheet (25,000 square miles) in about four to six weeks, if he works solidly, and has adequate keys. But, and here the adequacy of his training comes in question, he will do his job well only if he has a thorough training in landscape morphology, in Carl Sauer's sense, and I question if the university training in geography is always sound enough, broad enough and morphological enough to justify this hope.

I might add that photographic interpretation renders field-work out of date, and at the same time renders field-work more than ever necessary. Much of what we at present do by field methods should be done in the laboratory. Then, when we know from our photographic work where the problem areas lie, we can do our field studies, a hundredfold more efficiently.

Here, then, I believe is the path we should follow. National inventory of land and resources is our goal, with conquest of distance and colossal spaces the problem. A scale of survey larger than we at present attempt is the need, and the aerial photograph the tool. Here, I suggest, is our chance to show our scientific colleagues that we can contribute uniquely to the national life and to the progress of scholarship. And in the doing of it, we shall be practising (while re-discovering Canada) one of the finest of the academic arts, the art of geography in its full sense.

THE CANADIAN ASSOCIATION OF GEOGRAPHERS

PROCEEDINGS OF THE FOURTH ANNUAL MEETING

The Fourth Annual Meeting of the Canadian Association of Geographers was held in Winnipeg, at the University of Manitoba, from May 27th to May 29th, 1954.

Thursday, May 27th

The formal meetings came to order with a welcoming address from the Vice-President of the University of Manitoba. The programme then proceeded as follows:-

10 a.m. General Session

J. Ross Mackay, University of British Columbia, presiding

Trevor Lloyd, Dartmouth College, Hanover, New Hampshire, U.S.A.,
Iron Ore Production at Kirkenes, Norway.
M.C.V. Douglas and R.N. Drummond, Arctic Institute of North America,
Air Photo Interpretation of Glacial and Physiographic Features of Quebec-Labrador.
E.M. Neil and D.F. Putnam, University of Toronto,
Observations Concerning the Keewatin Centre of Glaciation.
G.H. Michie and E.M. Neil, University of Toronto,
Cultural Conflict in the Canadian Arctic. (Paper read by D.F. Putnam.)
R.W. Packer, University of Western Ontario,
Note on the Annual Periodicity of Daily Rainfall in Canada.

2 p.m. Session on Planning

N.V. Scarfe, University of Manitoba, presiding

G.A. Hills, Ontario Department of Lands and Forests,
Regional Planning for Resource Management in Northern Ontario.
A.L. Farley, British Columbia Department of Lands and Forests,
Applied Geography in British Columbia. (Read by J.L. Robinson.)
A. Davidson, Saskatchewan Department of Natural Resources,
Role of Geographers in Saskatchewan.
G.S. Brown, Saskatchewan Department of Natural Resources,
The Application of Regional Surveys in Provincial Administrative Problems, with an example from the Buffalo Region of Northwestern Saskatchewan.
V.F. Valentine and R.C. Young, Saskatchewan Department of Natural Resources,
The Situation of the Metis of Northern Saskatchewan in Relation to his Physician and Social Environment.
E.G. Pleva, University of Western Ontario,
Geographic Aspects of Development Problems in Southwestern Ontario.

7:30 p.m. Business Meeting

J. Ross Mackay, University of British Columbia, presiding

The minutes of the business meeting have already been published in detail but the main items are repeated below for the record.

The Canadian Association of Geographers Award.

The annual book prizes, for the best essay or thesis submitted as part of the requirements for the first degree with specialization in geography in each Canadian University Department of Geography, were awarded as follows:-

Université Laval - Benoit Robitaille: "La dépression Cap-Rouge-Limoilou".
McGill University - No name announced as yet.
Université de Montréal - C. Laverdière: "La région de Sept-Iles, Etude Morphologique".
Université d' Ottawa - Hans Van Leeuwen: "L' Indonésie, aspect géographique".
University of Toronto - George H. Michie: "The Leaf Bay Sector of the Ungava Trough".
McMaster University - No name announced as yet.
University of Western Ontario - Robert McDaniel: "Certain aspects of military geography in relation to the Great Lakes-St. Lawrence Seaway Project".
University of Manitoba -
University of British Columbia - No award this year.

The Canadian Committee of the International Geographical Union.

The Chairman of this Committee, Dr. B. Brouillette, reported that on October 23rd, 1953, the Canadian Geographical Society relinquished its sponsorship of the Canadian Committee of the International Geographical Union in favour of the Canadian Association of Geographers. The Executive Committee of the Canadian Association of Geographers confirmed this change on December 28th, 1953.

Committees.

The New Executive Committee was elected as follows:

President:	B. Brouillette
First Vice-President:	J.W. Watson
Second Vice-President:	L.E. Hamelin
Secretary:	Marion H. Matheson
Treasurer:	J.K. Fraser
Asst. Sec. Treasurer:	P. Camu
Councillors:	J.B. Bird
	F.K. Hare
	N.L. Nicholson
	J.M. Roy
	T. Weir

The Southern Ontario Division.

The annual meeting of the Southern Ontario Division of the Canadian Association of Geographers was held in the Mills Memorial Library at McMaster University, Hamilton, on January 30th, 1954, with Harold Wood, Division Chairman, presiding. Nine papers were read during the day. These papers represented current geographic research in the Departments of Geography of the University of Toronto, the University of Western Ontario, and McMaster University. At the evening banquet Dr. F.K. Hare, Chairman of the Geography Department of McGill University, spoke on the "Re-Exploration of Canada". The new officers of the Southern Ontario Division are John Warkentin, University of Toronto, Chairman, and Spencer Inch, Weston Collegiate and Vocational School, Secretary.

9:30 p.m.

Reception at Residence of N.V. Scarfe, Dean of Education, University of Manitoba.

Friday, May 28th

9 a.m. General Session

B. Brouillette, Université de Montréal, presiding

H.H.B. Richards, University of Toronto,
Agricultural Patterns in the Precambrian Area of Southern Ontario. (Read by D.F. Putnam.)

F.K. Hare, McGill University,
Mapping of Physiography and Vegetation in Labrador-Ungava; a review of reconnaissance methods.

T.L. Hills, McGill University,
The Canadian Asbestos Industry.

M.K. McCutcheon and R.C. Young, Saskatchewan Department of Natural Resources,
The Development of Uranium City.

L.E. Hamelin, Université Laval,
Un puissant Exemple d' Emigration rurale à l' échelon Paroissial. (Title and abstract read by the Chairman.)

J.L. Robinson, University of British Columbia,
Population Trends and Distribution in British Columbia.

J.M. Roy, Université Laval,
La Grande Vallée de Californie.

2 p.m. General Session

J.L. Robinson, University of British Columbia, presiding

N.V. Scarfe, University of Manitoba,
The Teaching of Geography in Canada.

B. Shindman, University of Toronto,
The Optimum Size of Cities. (Read by F. Watts.)

N.L. Nicholson, Carleton College,
Trinidad Pitch.

A. Crerar, Lower Mainland Regional Planning Board,
Regional Planning in the Lower Mainland, B.C. (Read by J. Stager.)

After a brief recess, T. Weir, the chairman of the Convention Committee, gave an outline of the field trip and showed slides of the City of Winnipeg.

6:30 p.m. Dinner Tendered by the University of Manitoba

8:15 p.m. Joint Meeting with Manitoba Geographical Society

B. Brouillette, Université de Montréal, presiding

J. Ross Mackay, University of British Columbia,
Presidential Address - Geographic Cartography.

9:30 p.m. Reception in Faculty Club, University of Manitoba

Saturday, May 29th

9 a.m. Field Trip - Urban Winnipeg

Prof. Weir conducted a bus tour of the cities of Winnipeg and St. Boniface. Aspects of the urban geography were pointed out including the places and buildings of historical interest, the commercial centres, old and new industrial and residential areas. A fine view of the city and surrounding Lake Agassiz Plain was had from the top of the Royal Bank building.

1 p.m. Luncheon Tendered by Hudson' s Bay Company

2 p.m. Field Trip - Winnipeg Locality

The field trip to Bird's Hill and Lockport to the north of the city was conducted by Prof. Dean. Unfortunately heavy spring rains had made many of the roads impassable for the bus, thus forcing an abandonment of a considerable portion of the trip. Points of physiographic, cultural and historical interest were noted, including the Lake Agassiz Plain, Bird's Hill (an extensive kame or esker rising above the plain), the rural-urban fringe, Ukrainian settlements, and some of the early Red River settlement sites and buildings. The afternoon trip was highlighted by a lengthy tour of Lower Fort Garry, the only intact Hudson' s Bay fort remaining, arranged by the Secretary of the Manitoba Geographical Society.

FIRST MEETING OF 1954-55 EXECUTIVE COMMITTEE

At the first meeting of the New Executive Committee, the following Committees were appointed. The first name is that of the Chairman. In some cases, the chairman of the committee has been the only one appointed by the Executive Committee. He is responsible for the choice of one, two or more members of his committee.

Awards Committee:	T. Lloyd
Convention Committee:	According to locality (Toronto in 1955).
Education Policy Committee:	E.G. Pleva, G. Aumont, J.L. Robinson, N.V. Scarfe
Membership Committee:	J.W. Watson, D.P. Kerr, J.M. Roy, W.C. Wonders
Nomination Committee:	D.F. Putnam, P. Dagenais, J.R. Mackay
Project Committee:	B. Zaborski, H.O. Frind, T. Jost, H.A. Wood
Publications Committee:	N.L. Nicholson, Editor

THE CANADIAN ASSOCIATION OF GEOGRAPHERS GRADUATE PRIZE

The Executive Committee have announced that a prize of $250 will be awarded to the graduate geographer submitting the best essay on one of the following topics: -

Geographical aspects of winter in Canada, OR
Sources of industrial power in Canada.

Entries should be sent to the Secretary of the Association on or before December 1st, 1954. The selection of the winning entry will be made by the Committee on Awards appointed to serve during 1954-55.

EIGHTEENTH INTERNATIONAL GEOGRAPHICAL CONGRESS

The Eighteenth International Geographical Congress which is to be held in Rio de Janeiro, Brazil, has been tentatively scheduled for August 9-18, 1956. So that the Preliminary Circular may reach the greatest possible number of geographers, the Organizing Committee requests that all geographers not included in the World Directory of Geographers published in

1952 by the International Geographical Union please remit their names and addresses to:-

Prof. Hilgard O' Reilly Sternberg
Secretário Executivo
XVIII Congresso Internacional de Geografia
Av. Presidente Antonio Carlos 40, 9º andar.
Rio de Janeiro, Brasil.

Professor Sternberg should also be notified of any changes of address as set down in the Directory.

OBITUARY

Walter Ravenhill Brown Battle

1919-1953

By the drowning of Ben Battle in Baffin Island on July 13th, 1953, the Association lost a member of unusual charm and strength of character. He was born and bred in Yorkshire and read chemistry at Leeds University. A keen mountaineer, Battle became interested in the problem of corrie (cirque) formation and undertook two seasons of glaciological research in North East Greenland. In 1950 he went to Cambridge University to prepare a Ph.D. thesis on corries, under the direction of Mr. W.V. Lewis. The year 1952-53 he spent at McGill University as Senior Carnegie Fellow.

Battle' s attack was twofold. In the laboratory, he tested the resistance to shattering of different types of rock, under varying temperature fluctuations. In Greenland, Norway, Switzerland, and northern Canada, he installed electrical equipment in corrie bergschrunds, to measure the fluctuations actually occurring in nature. Some of his valuable findings are set out in the papers listed below; others may be published later.

1951. "Glacier movement in north-east Greenland, 1949; with a note on some subglacial observations". Jour. of Glaciology, Vol. 1, No. 10, pp. 559-563.

(With W.V. Lewis) 1951. "Temperature observations in bergschrunds and their relationship to cirque erosion". Jour. of Geology, Vol. 59, No. 6, pp. 537-545.

1952. "Contributions to the glaciology of North East Greenland, 1948-49, in Tyrolerdal and on Clavering Ø". Medd. om Grønland, Vol. 136, pp. 1-28.

1953. "Corrie formation with particular reference to the importance of frost shatter at depth". Cambridge University: incomplete and unpublished thesis. 181 pp.

1954 (?). Paper to be published in the Royal Geographical Society' s Research Series No. 3, devoted to corrie formation.

H.R. Thompson